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Selling Public Utility Bonds

In some recent cases the Board of Public Utility Commissioners of New Jersey has held that a public utility should get competitive bids when it sells bonds. This is, we believe, in accord with present public opinion. It is better for the large, ably managed public utility company to be free to market its securities when and where it chooses at the best prices that it can get. Many still cling to the practice that they have found successful in the past and do not like to sever relations with a single banking house. However, utilities have a credit standing that they did not have in earlier days. When a company was new a banker's name was generally needed to recommend securities and create a market for them with investors. The name of a well-known utility company on a bond means more now than it did then. The association of a single banking name with all of the bond issues of a company has dwindled in importance. If a solvent company has ability in its management to sell securities profitably and has resources ample to protect it reasonably well in panic, it can obtain better average prices by a consistent policy of competitive selling than by confining itself to a single banker who is undisturbed by competitors. On the other hand, if it lacks these qualities it may protect itself by affiliating closely with strong bankers who feel morally bound to provide for its needs. It should be borne in mind that the advantage of competitive buying is less apparent with small companies than with large properties. The reason for this lies in the fact that frequently the small amounts of bonds sold from time to time by the plant having little output can be disposed of at a minimum of expense by a banker who, through a previous transaction, has become familiar with the property.

The Problem of Distribution

The description in this issue of the engineering work of the Commonwealth Edison Company of Chicago gives the reader a vivid idea of the immensity of the task of the great central-station organization outside of its generating plant. Delivering the energy at the switchboard is the least of the difficulties of a modern electricity supply company. The greatest of its tasks is to maintain continuous service over the increasing territory and to give approximately uniform voltage to its consumers. When the duties of the engineering staff lie in a metropolitan territory they are serious indeed. In the first place, the company does most of its own construction work and supervises rigorously all the rest. Such construction ranges from substations and cable conduits to high-tension transmission lines and tunnels under the river to accommodate more cables. For the past five years the engineering department has had to handle about 1,500,000 lb. of copper annually in paper-insulated, lead-covered cable. A hundred thousand feet of miscellaneous standard sizes of such cable are often kept in stock. The overhead circuits consist of 20,000-volt, sixty-cycle, 12,000-volt, sixty-cycle, 9000-volt, twenty-five-cycle, and a large amount of 4000-volt, four-wire, three-phase distribution circuits. More than 3000 miles of wire has been erected for the overhead service. At the present rate of extensions, a very considerable force will have to be kept busy merely on the installation and maintenance of such lines. Then there are forty-eight substations to be operated, with 184,000 kw in equipment of miscellaneous apparatus, including twenty-three storage batteries. The complete operation, maintenance and management of these substations with the accompanying necessity of united working is a problem of the gravest character, for the conditions are vastly more severe than if these forty-eight were separate central stations scattered over three or four states. Such magnitudes are involved in the every-day working of the Commonwealth Edison Company. Even the most well-seasoned engineer will find in reading about them a new light on the real meaning of electricity supply on a large scale.

Recording Devices for Central Stations

In his A. I. E. E. convention paper Dr. C. P. Steinmetz makes a plea for the use of suitable recording devices in a central station to indicate the sequence of surges or disturbances in the system on such a time scale as will enable the entire series of phenomena to be unraveled at the leisure of subsequent investigation. Even trained observers who are warned in advance as to the nature of the phenomenon that is about to occur are likely to err in their records of an event as smooth and long-lasting as a solar eclipse. What reliance, then, may be placed upon the unrecorded statements of untrained observers, suddenly roused to a pitch of high mental excitement by an unlooked-for violent disturbance, which may last only a few seconds? Nevertheless, when damage is done, it is important to know what particular part of the system first gave way. Hence some trouble and expense may well be borne, by way of insurance, in providing for suitable automatic recording devices such as the multi-recorders advocated by Dr. Steinmetz.

The Late Prof. E. J. Houston

The sudden death of Dr. Edwin James Houston, whose obituary notice appears in this issue, has taken from the ranks of electrical engineers in this country one of the most notable pioneers. Professor Houston was eminent as a scientist, writer and inventor, but he was pre-eminent as a teacher. In the early days of electric arc-lighting, in association with Prof. Elihu Thomson, he did much to improve the dynamo and the electric lamp. Many a man less gifted in engineering ability than he would have preferred to give his entire time to the development of the Thomson-Houston Company in the days of its early success. He elected, however, to retain his post as a teacher in the Philadelphia Central High School; so that, although connected with engineering and engineering business throughout his life, he always regarded his teaching work as of the first importance. Hundreds of Philadelphia men in every walk of life to-day are stronger, clearer-thinking and finer men because in their youth they came under Houston's influence. In his later years the recognition of so many of his boys of earlier days was a constant source of pleasure to him.

Intellectually, he was always a champion and exponent of clear and simple expression in speech or writing. He liked strong, terse Anglo-Saxon sentences. He vigorously disliked rambling and indefinite utterances or writings. His school textbooks on natural philosophy, applied electricity and forestry were very widely used and are models of the English literary style he advocated. In return, that simple directness of expression was one reason for the popularity of his books among young people. Personally, Professor Houston was a hard worker, earnest, persistent, temperate and enduring. A strong advocate and friend, he always recognized courage and self-reliance in others. He was a powerful man who contributed much to the earlier growth of electrical engineering and, in every phase of a long and active career, rounded out a life of widespread usefulness.

Operation of Suspension Insulators

Mr. H. W. Buck's paper on suspension insulators, read before the midwinter convention of the American Institute of Electrical Engineers, brought out some very interesting facts concerning the wind deflection of suspension insulator strings supporting conductors in a transverse gale of wind. Allowing 15 lb. per sq. in., or 7.5 gm per sq. cm, of projected conductor area as the maximum wind pressure to be taken into account, the author showed that all but the smallest sizes of copper-stranded conductor have sufficient weight for the longitudinal area to keep the angle of deflection within 60 deg. from the vertical. On the other hand, aluminum conductors are relatively so much lighter per unit of longitudinal area that, with the same wind velocity, they are capable of deflecting some 70 deg. or more. This range of deflection becomes a serious matter, not only in regard to the electrical behavior of the insulator but also in regard to mechanical impacts and entanglements. It is pointed out that the use of cast-iron weights, suspended below the aluminum wires at the insulator, have been found to produce satisfactory results in anchoring the lines against wide deflections as well as against accidental longitudinal displacements.

Recommendations are also made in favor of deadending the lines at frequent intervals and of not permitting more slack than is necessary to guard against the stresses of heavy gales in cold weather. Some engineers are inclined to allow extra slack as an extra safeguard of strength, but it is pointed out that this may do more harm than good in a gale of wind.

The Cost of Electrical Energy

Mr. H. M. Hobart's A. I. E. E. paper on the cost of generating electrical energy in bulk started as lively a discussion as we have had the pleasure of hearing for a long time. We preface our consideration of it by stating in the plainest possible terms that we do not agree fully with either side. It is quite certain that the costs stated by Mr. Hobart are lower than there is a reasonable chance of obtaining in practice in any concrete instance. In other words, the author's values are irreducible minima requiring a highly improbable combination of favorable circumstances. On the other hand, the resulting discussion raised in general a ground of objection which we consider thoroughly unsound, in that it took exception to the figures given by the author not so much on the ground that they are too low as from the fear that, being too low, they would exercise a baneful influence on central-station interests by setting up for the benefit of state commissions and the like unattainable figures of excellence. This attitude we do not consider a wise one because the time has come when producers of electrical energy —whether they like it or not—must play with their cards on the table. We do not approve of the implication that the cards should be kept up their sleeves. It is time to face issues of this kind with absolute frankness and to show the public, represented by its commissions, as reasonable business men, the actual conditions which have to be met in furnishing public electricity supply. Moreover, we think there are very few big, broad-gage central-station men in this country who would hesitate to lay before a commission the true switchboard costs of their energy provided the conditions could be fully and fairly explained.

Nevertheless, Mr. Hobart's values are open to criticism as conveying too strong an impression of extreme cheapness, not because the assumptions are impossible, but because they are highly improbable. We do not believe that any electric plant capable of operating with the economy required by the conditions can be built in this country now or at any time in the near future for $35 per kw. If a plant capable of high

economy in operation could be installed for $50 per kw, we should be very much surprised, particularly if such plant were within reasonable striking distance of any metropolitan market. If it were conveniently situated with respect to such market, the cost would run very much higher still on account of investment in real estate.

Our chief criticism would be that Mr. Hobart's minimum first cost is too low for practical conditions, and that his load-factors, on which the extremely low costs are estimated, run to a range quite too high for ordinary practice. A 50 per cent load-factor is attainable, a 75 per cent load-factor is not without the range of possibility, but a load-factor of 100 per cent may as well be dismissed without discussion, as every central-station man knows to his sorrow. Taking account of these things, it is clear that the actual costs, with any reasonable value of the load-factor and price of coal, are quite certain to run much nearer to half a cent per kilowatt-hour than to the quarter cent or less used by Mr. Hobart. Unless we are much mistaken, there are some large plants now operating at not far from the figure indicated. However, from the standpoint of those who object to the moral effect of Mr. Hobart's statements, it makes little difference whether the real cost be 3 mills, 5 mills or 7 mills per kw-hr. Any and all of these figures are so far below the market price of delivered energy as to leave the bulk producer in about the same situation. It is not the cost of the raw material, so to speak, which counts in central-station supply, but the enormous and rapidly increasing cost of making it available to the consumer. We have faith enough in the public to believe that it can be brought to a comprehension of this fact in the same way that it realizes the difference in equitable price per pound between wool and broadcloth.

Single-Phase for Swiss Railways

Recent numbers of *La Lumière Electrique* contain a most instructive résumé of the studies made on the Swiss railway system for a general scheme of electrification now in process of being carried out. The fundamental situation in Switzerland differs somewhat from that found elsewhere. Since Switzerland is liberally supplied with water-power while entirely without native coal supply, there exists the natural desire to be independent of foreign coal supply for the operation of the national system of railways, over and above any economic advantage to be gained in railway operation through electrification. The very distinguished commission on which was laid the burden of selecting a system was directed to make a most thorough investigation, including not only the utility of electrical traction in general but also the most advantageous system to be employed and the details of cost in concrete projects which might show the actual economic advantages of electric traction in each. The commission took up the investigation in great detail and examined the three familiar systems now in use, the continuous-current system with third-rail or overhead conductor, the three-phase system with high-voltage contact line and the single-phase system with commutator motors, each of the three to be supplied with energy from hydro-electric plants. Consideration was given to continuous-current contactor voltages up to 3000, three-phase up to 8000 and single-phase up to 15,000.

From the installations already in use it was found that locomotives of adequate power could be obtained with any one of the three systems. In investigating the proper maintenance of the schedule requiring economical speed variation, the preservation of the running time with trains of all weights and the surmounting of grades at full speed, if necessary, the commission gave its preference to the single-phase commutator motor. In studying the relation of output to weight of the locomotives surprisingly little difference was found between the three systems, the weights ranging as follows: For continuous current, 110 lb. to 120 lb. per hp; for three-phase, 100 lb. to 130 lb., and for single-phase, 110 lb. to 165 lb. It will be noted that the minimum weights stated are extraordinarily close to one another, a slight advantage on the whole resting with the continuous-current machinery. In the matter of efficiency from busbars to wheels comparisons were more difficult, average values favoring the single-phase system, with continuous current a good second and three-phase very nearly the same.

As to the security of operation of the distributing system, the commission favored the single-phase line, and in its final report gave it the preference as possessing the greatest technical advantages, all things considered. According to the commission's final conclusion, for the conditions of the Swiss network of railways, both from the technical and from the economic point of view, the advantage lay with the single-phase commutator system operated at about fifteen cycles per second and 15,000 volts on the contact wire. The commissioners stated that the official studies made on Prussian, Bavarian, Austrian and Swedish railways led to the same positive conclusion, so that Switzerland would run no risk in following their example. Of course, it does not necessarily follow that the conclusions of the Swiss commission here set forth are to be considered applicable to all railways and all conditions, the margin of advantage in favor of any one of the systems not being conspicuously great. Moreover, in the investigation of every large system special local factors must be taken into consideration in deciding what is best to be done. However, from the character of the Swiss report and the consensus of opinion among engineers of other countries, one may safely say that the single-phase system is rather far from being out of the competition for heavy railway work. A close analytical study of the work of the Swiss commission is certainly worth making on the part of all those interested in heavy electric traction, proper account being taken of the varying factors which might not lead inevitably to the same result under different circumstances.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Storms Play Havoc with Overhead Lines

March was ushered in with severe snowstorms along the Atlantic Coast, which, although not unprecedented in fury, left a trail of death and suffering and a loss of millions. The steam and electric trunk lines had to suspend their regular schedules, the electric surface lines were completely tied up in many cities, telephone and telegraph communications were almost entirely cut off, and in not a few cities the overhead systems of the lighting companies were severely damaged. Owing to the entanglement of telephone and telegraph wires falling over the electric light wires, electric service was shut off as a precautionary measure in many places. Throughout the State of New Jersey, including Trenton, Newark, Jersey City, Hoboken and Camden, darkness prevailed owing to the breaking of wires under the weight of wet snow. Other places in which electric light service was entirely or partially interrupted were Staten Island, all of Poughkeepsie except Main Street, portions of Brooklyn, all of New London, Conn., portions of Scranton, Pa., large sections of Long Island, and sections of Philadelphia. On March 2 all of the cars of the Washington Railway & Electric Company and the lights of the Potomac Electric Power Company were put out of commission by a peculiar phenomenon. The strong wind blew most of the water out of the Eastern Branch of the Potomac River and the Bennings plant of the combined companies was obliged to shut down from lack of water. Wireless communication was utilized in places where the telegraph lines were down for transmitting news and commercial messages. The wireless of the Lackawanna Railroad was also pressed into service, although the railroad right-of-way itself was blocked by heavy snowdrifts in the Pocono Mountains.

Doherty Organization of Ohio Meets at Warren

Operators and managers of the Ohio properties of the Doherty Operating Company held their regular monthly meeting at Warren, Ohio, Feb. 28. After Mr. Edward Quillen, Alliance, had read a paper outlining methods of handling business in all branches, discussion turned to the subject of caring for troubles in the customer's home. The sentiment of all was voiced by Mr. C. H. Felker, of Toledo, who stated that patrons should be taught to look to the public-service corporation for relief from any electrical trouble and that troubles promptly remedied show the people that they can depend on the company. In a paper entitled "Accounting and Its Relation to Other Departments," by Mr. H. N. Beckett, Elyria, it was brought out that the new-business department could render valuable assistance by affixing to the signed contract a note relative to the credit of the customer. After a noonday dinner presided over by Mr. George Daugherty, of Warren, the seventy-five delegates witnessed a demonstration of the nitrogen-filled lamp manufactured by the Ohio Lamp Works of the General Electric Company. A paper on "Utilization of By-products of Steam Generating Stations," by Mr. A. C. Rogers, of Toledo, showed that generating units can be operated economically at back pressures if the exhaust steam is sold for steam heating in winter and for refrigeration in the summer. In discussing the sale of ashes as a by-product it developed that several plants had created a market for ashes and were selling them at 25 cents a load for use in concrete building and sidewalk construction. At a Jovian rejuvenation following the convention about thirty candidates were taken into the order. A Jovian delegation from Youngstown assisted in conferring the degrees.

Decision Preventing Re-sale Prices Upheld

In a decision rendered on March 2 the United States Supreme Court dismissed the appeal of the Waltham Watch Company from a decision of the Circuit Court of Appeals of New York in favor of a New York jeweler who sold watches below retail prices named in a contract. The company brought suit for an accounting and damages and an injunction restraining Charles A. Keene, the jeweler, from violating the agreement fixing re-sale prices.

Institutes of Radio and Electrical Engineers

The Institute of Radio Engineers will participate in the meeting of the American Institute of Electrical Engineers to be held at New York, March 13, under the auspices of the A. I. E. E. committee on telegraphy and telephony. Three papers will be presented, namely, "A Comparison of the Telegraph with the Telephone as a Means of Communication in Steam Railroad Operation," by Mr. M. H. Clapp, superintendent of the Northern Pacific Railway Company; "Traffic Studies in Automatic Switchboard Telephone Systems," by Mr. W. Lee Campbell, general superintendent Automatic Electric Company, Chicago, and "The Goldschmidt System of Radio-Telegraphy," by Mr. E. E. Mayer. The last-named paper will be illustrated by lantern slides. At the close of the technical session the meeting will adjourn to the A. I. E. E. headquarters, where a smoker will be held.

Buffalo Electric Show

The Jovian League of Buffalo, N. Y., has incorporated the Buffalo Electric Show Company, which will hold an exhibition in the Elmwood Music Hall, Elmwood Avenue and Virginia Street, Buffalo, N. Y., on March 9-14 inclusive. The electrical industry of Buffalo is back of the show and has raised a guarantee fund of $15,000 to insure its success. The show is designed to demonstrate to householders and manufacturers within a radius of 150 miles of Buffalo the economy, simplicity and convenience of electricity in all its uses. It is estimated that about 25,000 people will visit the exhibition, because there has never been a show held in Buffalo of its kind, and there probably

will not be another in years to come. The decorations will be very lavish, and the hall within and without will be brilliantly illuminated.

The central feature of the interior as planned will be an immense electric fountain, from which avenues will radiate past the exhibits. Mr. W. D'A. Ryan, illuminating engineer of the General Electric Company, who is also in charge of the illuminating effects of the Panama-Pacific Exposition, is acting as consulting engineer on lighting, so that artistic and spectacular illumination is assured. Special invitations have been issued to contractors, central-station managers, architects, consulting engineers and engineers of large municipal plants, who will be the guests of the show committee. The electrical fraternity is well represented on the committees. Mr. W. E. Robertson, general manager of the Robertson-Cataract Electric Company and one of the best known jobbers of the country, is chairman of the space and exhibit committee; Mr. E. D. McCarthy is general chairman of the show, and Mr. H. S. Hilliker is secretary. The general offices of the show are in the Electric Building.

Proposed Electrical Code in Wisconsin

Tentative rules governing the installation and maintenance of electrical equipment in Wisconsin have been drawn up for the Industrial Commission of that State by a committee consisting of Messrs. Thomas E. Barnum, Milwaukee, Cutler-Hammer Manufacturing Company; Charles Dietz, Milwaukee, Commonwealth Power Company; W. F. Gute, Milwaukee, Federated Trades Council; Walter Nield, Milwaukee, Illinois Steel Company; P. A. Schroeder, Milwaukee, Henry Newgard Company; S. B. Way, Milwaukee Electric Railway & Light Company, and C. W. Price, assistant to the Industrial Commission. This committee has given several months of careful study to the subject and has consulted all available authorities in order to fix a Wisconsin standard. Hearings will be held in the rooms of the Industrial Commission in the State Capitol at Madison, beginning at 10 a. m. on March 13. After public hearing the manner of carrying the electrical code into effect will be indicated by the Industrial Commission under the authority conferred upon it by law.

Co-operative Movement in Chicago

A Chicago committee to further the work of the Society for Electrical Development has been announced. It is made up of Messrs. W. R. Bonham, Triumph Electric Company; E. H. Cheney, Wagner Electric Manufacturing Company; W. H. Colman, General Electric Company; J. S. Corby, Bryan-Marsh Electric Works; W. T. Dean, General Electric Company; G. B. Foster, Commonwealth Edison Company; Ernest Freeman, Freeman-Sweet Company; Stephen Gardner, Westinghouse Electric & Manufacturing Company; T. P. Gaylord, Westinghouse Electric & Manufacturing Company; John F. Gilchrist, Commonwealth Edison Company; H. L. Grant, Western Electric Company; A. A. Gray, *Electrical Review and Western Electrician;* W. E. Keily, *Electrical World;* W. W. Low, Electric Appliance Company; William McGuineas, United Electric Construction Company; J. C. Monroe, Bryan-Marsh Electric Works; H. E. Niesz, Commonwealth Edison Company; Franklin Overbagh, Overbagh & Ayers Manufacturing Company; E. D. Payne, General Electric Company; W. R. Pinchard, Westinghouse Electric & Manufacturing Company, and D. H. Wyre, Buckeye Electric Division. Mr. A. A. Gray, who has done much earnest and effective work for the society, is the secretary of the committee. Mr. Niesz is the chairman of the central-station division of the committee, Mr. Gaylord of the manufacturers, Mr. Freeman of the contractors, and Mr. Grant of the jobbers. A preliminary meeting of members of the committee was held on Feb. 27.

Meeting of New York Electrical Society

The 326th meeting of the New York Electrical Society was held on Feb. 27 at the recently completed generating station of the United Electric Light & Power Company at 201st Street and Harlem River, New York City. About 300 were in attendance. Mr. Frank W. Smith, vice-president and general manager of the United Electric Light & Power Company, reviewed briefly and illustrated by means of lantern slides some of the interesting incidents in connection with the early history and development of the company. Mr. Smith is one of the pioneers in the electrical field in New York City, and he has had an unbroken connection with the United Electric Light & Power Company and its predecessors for the past thirty-three years. The data given by Mr. Smith were very much the same as those published in the *Electrical World* of Feb. 7 in connection with the description of the company's station, obtained from the same source. Following Mr. Smith's talk, Mr. Leitch, electrical superintendent of the company, gave an illustrated detailed description of the plant (see *Electrical World,* Feb. 7 and 14), after which those present were conducted on an inspection tour of the station.

Electric Vehicle Dinner at Boston

To mark the third anniversary of the inauguration of its electric-vehicle campaign the Edison Electric Illuminating Company of Boston tendered a complimentary dinner on March 3 to the Boston Electric Motor Car Club and other invited guests. More than 150 persons were present. Mr. Day Baker, Boston, introduced as toastmaster Mr. Frank W. Smith, New York, president of the Electric Vehicle Association of America, and brief addresses were made by Messrs. W. J. Keville, Boston; E. S. Mansfield, Boston; J. M. Curley, Mayor of Boston; C. H. Miles, Boston; P. D. Wagoner, Long Island City, N. Y.; H. H. Rice, Indianapolis, Ind.; D. C. Jackson, Boston; W. D. Sohier, Boston, and J. H. McAlman, Boston.

Mr. Mansfield reported that in 1910 at the outset of the campaign there were 119 electric passenger vehicles and 50 electric trucks in Boston. In 1913 the pleasure cars numbered 255 and the trucks 208, making a total of 463, or an increase of 174 per cent. In the Boston suburban territory there were in 1910 238 pleasure cars and 173 trucks, a total of 411. In 1913 these numbers had been increased to 604 pleasure cars and 409 trucks —a total of 1013 electric vehicles, showing a gain of 146 per cent during the three years of the Edison company campaign. Half of the electric vehicles in the State of Massachusetts are supplied with energy from the lines of the Boston Edison company.

Mr. Miles declared that 34,075 electric passenger cars and 17,687 electric trucks are in use in the United States. Recent experiences with the successful operation of electric trucks during heavy snows have demonstrated the superiority of this form of haulage where other types of cars were being towed in. Mr. Wagoner

said that the cost of horse mortality aggregates $130,000,000 per year. He estimated that about a million trucks would be required to perform the haulage now done in various ways, and showed that at $1,000 each this possible truck business would represent a value of $1,000,000,000. Mr. Rice insisted that the vehicle salesman believe thoroughly in the product he sells. In discussing the effect of the predicted "cheap" electric car on other established lines of vehicles, Mr. Rice said he would welcome such a car since it promises to introduce the electric vehicle to a widening group of prospective purchasers, but he expressed hope that the promised cheap car would be well built and "a good car."

A feature of the dinner was the state entry of President Smith enthroned on a dais carried on a battery-driven industrial truck, which was afterward employed by Mr. L. D. Gibbs, in charge of advertising for the Boston company, who, garbed as Lucifer, motored among the diners dispensing good cheer and song.

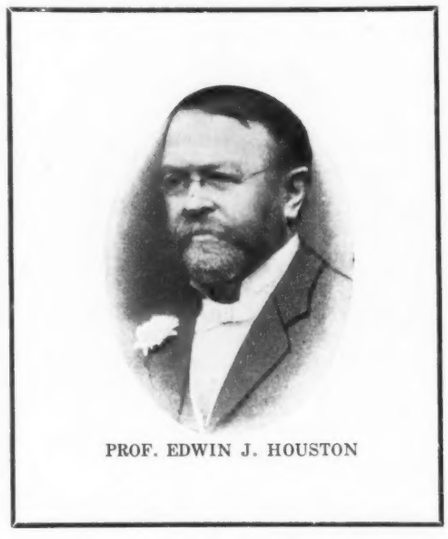
Prof. Edwin J. Houston Dead

Prof. Edwin James Houston, whose intimate association with the development of electric arc lighting has made his name familiar to every one even casually interested in electrical affairs, died at his home in Philadelphia of heart disease on March 1. Professor Houston was also widely known as an educator and author. He was born in Alexandria, Va., July 9, 1847, and educated principally in the public schools and in the Central High School of Philadelphia, which institution he served long and faithfully as professor of physical geography and natural philosophy. He first taught at Girard College, and not long afterward was elected professor of civil engineering in the Central High School, only to be transferred a year or two later to the chair of natural philosophy, of which he was professor emeritus at the time of his death.

About 1879 Professor Houston took up the then comparatively new subject of electric lighting and in conjunction with Prof. Elihu Thomson, who like himself was a teacher in the Philadelphia public schools, elaborated the Thomson-Houston system of arc lighting which in 1881 made its appearance and not long afterward won its way into prominence all over the civilized world, although it is now gradually being superseded by mercury-arc rectifier sets. The Brush arc machine was already in use at that time, and the appearance of the Thomson-Houston dynamo created somewhat of a sensation. Its spherical armature was unique among armatures; its cup-shaped field magnets were unique among field magnets, and its three-part commutator was unique among commutators. The dynamo embodied many novel features, not the least of which were the air blast used to extinguish the sparks occurring as the segments passed under the brushes, and the regulating magnet and gear used for automatically shifting the brushes so as to maintain a constant current.

Of the splendid work accomplished during the partnership of Professors Thomson and Houston little need be said, as it forms part of the history of modern electricity. Professor Houston was one of this country's pioneers in electric arc lighting, and his numerous inventions met with deserved success. In 1884 he was appointed by the national government a member of the United States Electrical Commission, which convened in Philadelphia, and he was also elected by the Franklin Institute chief engineer of the International Electrical Exhibition. A very large amount of interesting scientific work was accomplished at that time, and the Philadelphia exhibition was well carried out and was singularly successful. The practical tests of electrical apparatus then made were a valuable contribution to science.

Since 1884 Professor Houston had become prominent in electrical research and investigations of every sort, and he devoted not a little time toward the popular exposition of the science in which he had attained so enviable a reputation. He resigned from the Central High School about 1895 and became associated with Dr. A. E. Kennelly, now of Harvard University, as a consulting electrical engineer, and he maintained an office in the Roger Williams Building, Philadelphia, as a consulting engineer up to the time of his death. His contributions to the literature of natural science have been numerous, and a considerable number of meritorious books have come from his ready pen. Of his fifty-two books the best known to the electrical fraternity are the "Dictionary of Electrical Words, Terms and Phrases," "Electricity in Every-Day Life" and the electrotechnical series written in collaboration with Dr. A. E. Kennelly and published by the *Electrical World* years ago. The latter were among the first primers on electrical subjects appearing in any language.



PROF. EDWIN J. HOUSTON

In his long professional career Professor Houston gave a large amount of attention to public lecturing and did admirable service to the advancement of science by his course of public lectures. It was as a stanch friend of the boys of the Central High School that Professor Houston was known and loved by thousands of alumni through the United States. His keen sympathy with boyish problems and his intelligent understanding of their aims and ambitions endeared him to many men once his students but now among the most prominent business and professional men in Pennsylvania. Professor Houston was president of the American Institute of Electrical Engineers in 1893, 1894 and 1895. He was professor emeritus of physics at Franklin Institute, professor of physics at the Medico-Chirurgical College, a member of the American Institute of Mining Engineers, the American Philosophical Society, the Electrotherapeutic Society, the American Historical Association, the New York Electrical Society, the Philadelphia Academy and numerous other scientific organizations. He was president of Section C of the Electrical Congress held in Chicago in 1893 and the first president of the electrical section of the Franklin Institute. He received the honorary degree of Ph.D. from Princeton University. Professor Houston was a bachelor. A brother and two sisters survive him.

In Memoriam—Prof. Edwin J. Houston

BY ELIHU THOMSON.

Thirty-five years ago, while Professor Houston and I were colleagues in the Central High School in Philadelphia, we were closely associated in work which later gave rise to the Thomson-Houston Company and its branches in other countries. It happened that after I left Philadelphia, in 1880, to become electrician for the new enterprise, which afterward took our joint names, we met only occasionally, so that the memory of Professor Houston in those early days is naturally now uppermost in my thought.

There were many reasons why at that time the bonds of sympathy and friendship should be closely drawn around us. From 1870 to 1880 we taught in closely allied branches of science, and in adjoining rooms in the old school; we assisted each other in planning and preparing lectures; we served on committees together; we collaborated in experimental work and in publication of results.

Though my senior by eight or nine years, he did not lack in youthful buoyancy of spirit and enthusiasm for any work undertaken, a quality which I think must have remained with him through life. He dealt with the students under him as a sympathetic friend, as well as instructor, and though he held them to a high standard he was a general favorite among the professors in the school. He was keenly alive to the then growing importance of science in education, and spared no effort to build up his department by securing for it the best apparatus for physical demonstration then available. In those early years, as later, he was a prolific writer, chiefly of review articles and textbooks. One of these books I well remember. It was his "Physical Geography," which became widely used in schools, and which went through several editions. Our joint inventive work covered but the short period of about two years, during which a number of patents which formed the basis of the Thomson-Houston arc lighting plant were taken out. While this work was in progress Professor Houston never shrank from the hard effort involved, lasting in many instances past midnight, or all night. His aid and sympathy in these early and strenuous days were invaluable when, as was natural, many discouragements arose.

Though after 1880 he took no active part in the inventive or engineering work of the enterprise bearing our joint names, he was always eager to follow its development, founded as it was upon the early trials and experiences in which he took so prominent a part.

Round-Table Convention of Commercial Men of Ohio Central Stations

Approximately seventy delegates, representing the new-business departments of Ohio central stations, electrical contractors and manufacturers in the State, convened at the Elks' Home in Toledo on Feb. 25, to interchange ideas on central-station commercial methods. The convention was welcomed to the city by Mr. F. R. Coates, president of the Toledo Railways & Light Company. In opening the sessions Mr. T. F. Kelly, Dayton, chairman of the committee on new-business co-operation of the Ohio Electric Light Association, called attention to the fact that this was the first time the new-business men of a state association had attempted getting together at any time other than the annual meeting. Round-table spirit with free and open discussion marked the convention.

Plans for Securing New Business in Small Cities

In his paper entitled "Plans for Securing New Business in Small Cities" Mr. H. G. Bonner, Elyria, pointed out that the basic element on which all new-business operations should be conducted is an up-to-date card index containing all information which can be obtained by a house-to-house canvass of the city. While a wiring schedule upon which contractors have agreed is often useful in residence campaigns for wiring old houses, it is impracticable to attempt such methods where store wiring is chiefly concerned. Likewise, the speaker said, while 1-cent postage is sufficient in many cases for circular letters sent to prospective residence customers, 2-cent stamps should always be used when business houses are being circularized. All advertising of this or any other character should be followed by calls from solicitors. Morning meetings of solicitors were recommended to instil enthusiasm into the men.

Speaking of show-window and sign lighting, Mr. Bonner said that the former could be handled by the local sales organization but the latter should have the attention of a special sign salesman. Original design in electric signs helps sell signs to competitors among local merchants, on account of the ever-prevalent desire of the retailer to outdo the most spectacular feat of his business rival. In closing, the speaker said that fair and courteous treatment of customers would more than any other one thing increase the success of the new-business department of any central station.

Discussion

A spirited discussion followed the paper and lasted throughout the entire morning session. Mr. T. F. Kelly, Dayton, commented on the fact that in an organization where there are but four solicitors, as at Elyria, daily sales meetings are held. He also reiterated the author's statement that enthusiasm is one of the greatest assets of the successful salesman. "Set a high mark and strive for it," was his advise to new-business men.

In reply to a question asked by Mr. F. C. Morrison, Newark, Mr. Bonner said that in following the wiring schedule used by the Cleveland Electric Illuminating Company a general reduction of 28 per cent had been made to accord with the lower overhead costs among contractors in Elyria. The prices under the schedule used in Elyria range from $13.68 for five outlets to about $78 for fifty-five outlets, these prices not including hardware and fixtures. In Mr. Bonner's belief it is better to start with the price schedule high enough to insure profit to the contractors, later reducing prices if found feasible.

Answering a question asked by Mr. E. H. Cobb, Toledo, Mr. Bonner explained that with proper division of card indexes the Elyria solicitors visit every customer at least once in sixty days and see all "live prospects" oftener.

Mr. W. J. Young, Toledo, in bringing up the subject of postage on circular letters, said that the first letter sent in a campaign should bear a 2-cent stamp although the remaining letters might fare just as well with 1-cent postage. Mr. E. R. Kelsey, Toledo, said that although many advertising men favor the 1-cent stamp for residence customers, he personally recommended the 2-cent stamp and would surely advise its use in small communities where mailing lists are not large. Mr. J. E. North, Springfield, solved the stamp problem, he said, by using 2-cent stamps only for the better residence districts and business districts. In reply to a question from Mr. H. L. Montgomery, Newark, Mr. Kelsey said that in Toledo letters are addressed to the

mistress of the house when her name can be obtained.

Following a short talk by Mr. O. E. Wessel on methods used in Columbus campaigns, Mr. P. A. Staples, Sandusky, said that some new-business men of Ohio might be surprised, as he was, to learn how many wired houses on their lines are not using service. A survey in Sandusky, he said, had shown 300 of these houses. However, a solicitor placed at this class of work regained 20 per cent of the 300 in one month.

Manufacturer, Contractor and Central Station

After luncheon had been served in the convention room, a paper dealing with methods of co-operation between manufacturing, contracting and central-station interests was presented by Mr. P. L. Miles, National Quality Lamp Division of the General Electric Company, Cleveland. In this paper the speaker outlined the various methods through which central stations and contractors are combining their efforts in old-house-wiring campaigns and explained how the electrical manufacturers stand ready to help enterprising contractors with advertising literature and attractive window displays. The speaker pointed out, however, the fallacy of using a good window display and keeping a disorderly shop behind it. A contractor's store should be one to attract the woman, for it is she who is the buyer of electrical appliances just as she is the purchaser of groceries for the home. In commenting on the expedient of hiring girls as saleswomen for contractors' stores, the speaker declared that manufacturers' salesmen are always ready to instruct such clerks in the talking points, prices and advantages of electrical wares, and he said further that this plan has been particularly successful where the girl is able to help with bookkeeping and typewriting. Contrasting this method with the former practice in which "Bill" the wireman was both salesman and journeyman, Mr. Miles pointed out the increased effectiveness of the improved plan.

Discussion

Speaking of the manufacturers' co-operative attitude, Mr. T. F. Kelly, Dayton, told of an offer made by Mr. S. T. Doane, Cleveland, inviting electric-service properties in Ohio to send a man to the National Quality Lamp Works for two or three weeks' free training in the science of illumination.

Mr. E. F. Miller and Mr. G. T. Groff, Toledo contractors, both spoke highly of the co-operative fixed-schedule plan for old-house wiring, stating that its success in Toledo had been marked and that it had afforded profit to all.

Evils in the Lamp Trade

Mr. A. A. Pointer, Antwerp, opened an interesting discussion by asking Mr. Miles why the lamp companies put lamps on commission in hardware and grocery stores and even blacksmith shops, while he was required to sign an annual contract in order to receive his discount. He said the sum involved was small but that the discrimination did not seem fair to him. Mr. D. L. Davis, Salem, said that a like condition existed in his city.

Mr. L. C. Anderson, Franklin, stated that this condition was not a purely local affair, for he had heard similar complaints from small central stations in all parts of the State. He said further that in his territory one lamp company's salesman had sold a retail dealer 112-volt and 114-volt lamps for 106-volt and 108-volt circuits to establish a life record for his product. Mr. Anderson said that his companies in no way considered the loss of profit from lamp sales, but they did object strenuously to the sale of lamps which lowered the quality of their service. He added, however, that he felt sure such things were due to the efforts of over-enthusiastic salesmen rather than to company policy.

The next meeting of the new-business men of the Ohio Electric Light Association will be held at Dayton April 8, and a later session has been planned for Cleveland during the forthcoming electric show in that city.

Price-Fixing on Electrical Devices

Most of the testimony presented before committees of Congress in regard to the pending trust legislation has come from other industries than the electrical industry. Recently, however, several prominent business men connected with some phase of electrical activity have offered testimony. Abstracts of the testimony of several are given herewith:

Testimony of Mr. James H. McGill.

Mr. James H. McGill, president of the McGill Manufacturing Company, of Valparaiso, Ind., testified that it had been his experience that fixing of the price to the consumer by the manufacturer tends to monopoly and to make it possible to charge a high price for the commodity. One of the chief arguments used is that manufacturers have built up the reputation of a trade-marked article and established the reputation of a trade name, and that if a cut in the price is allowed the reputation will be rendered valueless.

Mr. McGill said it is true that manufacturers have built up a reputation, but he failed to know from his personal knowledge where the expense of building it up was not paid by the consumer ultimately. The profit pays for building up the business. If the growing trade is stopped in an artificial way, it will be easier to create a monopoly. A good device may be brought out, but it is difficult to get the jobbers to handle it and promote its sale unless a guarantee of control of the price can be given. Another article that is well known will be offered and people will argue that it will answer the same purpose and that they like it and they are protected in selling. That comes from the fact, which is true of nearly all forms of business, that there are associations which meet at certain stated intervals and talk co-operation. They are co-operating against the consumer in most cases, Mr. McGill said.

In asking about the large electric companies, Representative McCoy said that there is a suspicion that they largely control the people who are making electrical devices of any kind. If he invented something, for instance, as he understood it, he could not get it on the market unless he came to terms with one of the large companies. Mr. McGill replied that that was wrong. Congressman McCoy declared that some of the companies will not permit the thing invented to be used in connection with any article that they are selling. If the thing can be sold under the law at a fixed resale price, would not that fact cut into the arrangement which the companies are said to make?

Mr. McGill said that he hardly thought so. The General Electric Company is not engaged in the general jobbing business as the General Electric Company. He added that there is no question, however, about its being interested in and controlling some jobbing houses. Mr. McGill said that he did not believe that the fixing of re-sale prices would help as much as it would hurt in other ways. The company does not control a large enough percentage of the jobbing output. Of course, the policy is changing from year to year.

Mr. McGill declared that if the source of supply is open to the coming generation, if it is not restricted in

one way or another, the man with small capital has certain advantages over the man with large capital. A large aggregation of capital alone will not stifle competition, because there will have to be high-class men to take care of that business and the point will be reached where the large unit is not especially efficient.

Continuing, Mr. McGill said that there will not be monopoly if there is not restraint of trade. The question of price maintenance in relation to the so-called advertised article goes a long way into the question of the high cost of living. He came to this conclusion by observation and what he had seen in his life of the change in business. When he went into the electric business, twenty-five years ago, it was comparatively a small business. There was no price maintenance.

In speaking of the changes, Mr. McGill said that three or four times a year the jobbers at considerable expense meet in some good place and talk over the situation. He had never been a member of that association and never attended any of the closed meetings, but understood that the leading jobbers who go to the meetings get up and tell the other jobbers, their competitors, how much it costs them for an order, what percentage is gross and what their gross percentage was on last year's business, and that the large jobbers use this information in meeting competition. As far as he knew, this is lawful, but the result is that the price stays up for the consumer.

Continuing Mr. McGill took up the subject of sockets. He said that in the Canadian market, where there is the keenest competition on the same article, with no attempt at fixing re-sale price, where the volume of business is very much greater and where a considerable part of the sockets consumed are imported and duty is paid thereon, the price is about 20 per cent less to the consumer. Mr. McGill declared that prices were fixed on sockets formerly, but that that could not be done now after the recent decisions of the Supreme Court. In answer to a question from Representative McCoy as to whether there had been any effect on the price, Mr. McGill replied that there had been a little but not much. He added that the price could not be fixed by law, but "they are all good friends."

In closing, Mr. McGill said that he believed it wrong in practice to allow the manufacturer to fix the re-sale price and it seemed to him that every man had a right to his own. It is good morals to prevent monopoly, and the fixing of prices is an aid to monopoly.

Mr. Herbert Noble, Representing John A. Roebling's Sons Company

Mr. Herbert Noble, representing John A. Roebling's Sons Company, said that the Sherman anti-trust law was a great piece of remedial legislation. The Sherman act provides that every restraint of trade which harms the public interest is unlawful. There is no such thing as a reasonable restraint of trade which harms the public interest. The right of freedom of contract is quite as important to preserve as any other of our great rights so long as that freedom of contract does not invade the public interest and do harm to the public.

Mr. Noble declared that anything that means healthy growth of man's business has always been permissible and is not a restraint of trade harmful to the public interest, although it may be argued that there has been a restraint of competition or even a restraint in fact to some extent of trade. There may be the making of many contracts which, under a given set of trade conditions, made for a given set of purposes, are perfectly lawful, whereas exactly the same combinations, partnerships and contracts if made under other trade conditions and for different purposes would be unlawful. To attempt to say that the making of all combinations, partnerships or contracts which in any way restrict free and unlimited competition or restrict trade is unlawful is to extend the common-law doctrine in respect to restraints of trade and attempts to monopolize and to enlarge the meaning of the Sherman act to such an extent as will make combinations, partnerships, contracts and the normal and healthy growth of industry, which are utterly without harm to the public, unlawful.

Decisions of the courts, Mr. Noble added, have gone to such an extent as to make it perfectly clear that no matter what means, methods, devices, combinations or conspiracies men may enter into, the effect produced may become unlawful if there is a restraint of trade harmful to the public interest. If those contracts and combinations do not produce a restraint of trade harmful to the public interest, they are innocent and may be protected.

Mr. Noble made a number of suggestions for changes in the various bills. He declared that the Sherman act when applied is effective. The decisions of the court are clear. The change in the public view in the last few years is marvelous. Instead of having the country trying to evade the law, the sentiment of the country is to obey the law. If new laws are passed which create difficulties and do not go to the result but go merely to the means, a condition will be produced where men are thrown into doubt and perhaps evasion.

In the course of his testimony Mr. Noble defended holding companies which control and finance lighting properties and are able to improve the service rendered to the public. Representative Morgan raised the question of over-capitalization through holding companies. Mr. Noble thought that the people are now protected by state public service commissions. He suggested that, in the case of a manufacturing company which he cited, subsidiary companies be required to state that they are branches of the parent company. Similarly operating companies whose stocks are held by a holding company that does not operate could be obliged to publish the fact that their stock or a certain percentage is held by the holding company. As to the prohibition of interlocking directorates, Mr. Noble suggested that responsibility be fixed by a provision that everybody who owns stock enough by a cumulative system of voting has to hold office.

The true way to meet the difficulty about an interstate trade commission, Mr. Noble believed, is to create a court or a body with quasi-judicial functions to which business men may resort. He did not propose a court to give immunity but a body to which business men might go with their affairs, have them heard and learn where they stand. This would not take away from the courts any of their present jurisdiction or take away activities of the Attorney-General or the district attorneys.

Hearing on New York State Water-Power Bills

The Velte-Smith hydroelectric bills were considered at a hearing before committees of the Legislature at Albany on March 3. The first part of the hearing was devoted to statements of those who opposed the bills while the remaining time was given to speakers who favor the measures.

Mr. George Clinton, of Buffalo, who spoke first, declared that the use of surplus waters of the barge canal for generation of power would lead to increase of these waters so as to generate as much power as possible. This is contrary to the principle of true conservation, as such an increase would lessen the flow of rivers. He expressed opposition to entrance by the State into the field of private enterprise. Various

speakers representing commercial undertakings in cities of the State followed Mr. Clinton with arguments against public ownership and operation of electric enterprises. Among those who spoke in opposition to the bills were Messrs. Charles W. Carpenter, Chamber of Commerce, New York City; Frederick B. De Berard, Merchants' Association, New York City; Edward N. Smith, Watertown; George H. Cobb, Watertown; William Dalton, Schenectady; Lorenzo Semple, Cohoes, and J. T. Hutchings, Rochester, and Prof. Olin L. Landreth, Union College, Schenectady, and Prof. W. L. Robb, Rensselaer Polytechnic Institute, Troy.

On account of lack of time, several who had prepared themselves to discuss the question were not heard and it was decided that they should file statements giving their opinions.

On behalf of those who favor the passage of the bills it was stated that they were not intended to interfere with developed water-powers but were designed to develop a plan for harnessing the undeveloped water-powers of the State. Among those who spoke for the bills were Mr. George E. Van Kennen of the State of New York Conservation Commission, Mayor Burns of Troy and Mayor Stevens of Albany.

Mr. Tripp on Anti-Trust Legislation

Mr. Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, made an address on "The National Government and Business" at the annual dinner given jointly by engineering societies in Boston on March 4. Mr. Tripp devoted his address to the subject of pending anti-trust legislation and enlarged on the ideas which he expressed in his paper before the Chamber of Commerce of the United States, an abstract of which was published in the *Electrical World* for Feb. 21, 1914. In his remarks at Boston Mr. Tripp described the proposed laws briefly and added that if anything he said should help to arouse his hearers to a study of the measures for themselves he would be satisfied.

Good business, Mr. Tripp declared, is the art of taking chances on probabilities, and poor business is perhaps the mistake of taking chances on possibilities; but almost no business is an exact science. That is to say, no business can be done without certain risks which have come to be called "business risks." Hence, after a lifetime given in that direction, a business man becomes educated to taking risks, and when he comes to view business legislation it is impossible to shake off his life's experience, and he finds himself saying: "Oh, well, if the law is so bad that it prohibits ordinary business methods, it will not be enforced and I will take chances on it. It is only another 'business risk.'"

Mr. Tripp called attention to the fact that every man who does an interstate business, however small and of whatever nature, will be affected by the legislation unless a specific limit of size is written into the bills, which would give an "immunity bath" to all violators of law who happen to be under statute size. Mr. Tripp expressed his belief that some regulation is necessary, not, however, from the standpoint of business efficiency or economical development of the wealth of this country, but because under our political institutions he prefers to see the menacing qualities of monopoly held in check by the establishment of conditions of sane competition rather than by strong direct governmental interference such as Germany exercises. He prefers to see conditions for fair competition established by proper legislation, if it can be done, rather than to see governmental ownership of railroads and other business enterprises for the purpose of securing the needed balancing influence. However, it would be regrettable if, in order to do this, a line should be drawn at say $3,000,000 and the men above that line should be told, "You may not do something," and the men below the line, "You may do it." That appears to be repugnant to the principles on which this government is founded.

After commending the Canada plan, Mr. Tripp declared that a modification of that plan, preserving the idea of a trade commission, might be desirable as one of the means for setting the machinery of investigation in motion and providing a flexibility which would render unnecessary the Sherman law definitions bill, which undertakes to define certain acts to be in restraint of trade that are now interpreted by the courts one way or the other as they are more or less small and insignificant.

Mr. Tripp believes that this commission might also assume the responsibility for bringing about the results sought in the trade relations bill, some of the provisions of which are well intended and aim at doing away with practices which should be condemned; but, in order to forbid them specifically, it may be necessary to use language which will make the statute apply to such an extent that business would be greatly, if not dangerously, hampered if the law were enforced.

Personally, Mr. Tripp thinks that it would be practically impossible fully to enforce the acts as they are now drawn; but it is objectionable to have laws on the statute books which cannot be fully enforced, and a properly framed trade commission bill seems to be a good substitute for specific legislation which leads no one knows where. For example, discrimination in prices for the purpose of injuring or destroying a competitor, or contracting that a purchaser shall not deal in the goods of a competitor, should be prevented; but, if it cannot be prohibited by definite statutes without causing more harm than good, to place the determination of the facts within the jurisdiction of a flexible trade commission is an admirable compromise. There might also be included among the powers of the commission the right to recommend the approval of the legality of a consolidation or merger, and when an approval has been so obtained the lawfulness of the exact thing approved should be beyond question.

The business legislation now proposed at Washington, Mr. Tripp declared, is probably more far-reaching than any other business legislation that has been attempted at any time in any country. It will be useless for "standpatters" to condemn indiscriminately all the measures proposed, because the great preponderance of public opinion favors the principles which the bills aim to sustain. Constructive criticism is needed. Condemnation will not destroy sound principles. Constructive criticism encourages safe and sound legislation.

One of the great principles supported by a public opinion that is little short of unanimous is that competitive conditions should be maintained, but it is quite likely that the public at large does not discriminate between free competition and fair competition. Free competition, Mr. Tripp added, would permit the manufacturer of a widely advertised article to say to jobbers and retailers, "I will not sell you my goods unless you agree not to sell any goods of my competitor," and thus gradually drive the competitor out of the market. This has been done and it was the intention to prohibit it by the trade relations bill. Instead of framing specific statutes to meet these conditions which are almost sure to ramify further and forbid quite harmless and proper business transactions, the duty of deciding whether a specific act is in violation of the principles of fair competition might well be performed by a commission.

Public Service Commission News

New York Commissions

The New York Public Service Commission, Second District, has rendered a decision on the application of the Canadian-American Power Corporation to engage in business, to issue stock and to acquire the Niagara Falls Electrical Transmission Company. The company sought to acquire a contract with the Electrical Development Company for furnishing 46,000 electrical hp produced in Canada and providing for the sale of this power in the United States, principally on or near the Niagara frontier. The company desired to issue $3,000,000 stock on account of the contract and $435,000 for the purchase of the Niagara Falls Electrical Transmission Company stock, bonds and debt.

The decision of the commission is that the applicant shall be restricted to a total of $1,250,000 stock on account of the contract and the acquisition of the Niagara Falls Electrical Transmission Company, of which $435,000 may be 7 per cent cumulative preferred, on condition that before any stock shall be issued or the entry of any order permitting issue of the stock or merger of the two companies shall be made effective, the applicant shall secure authority for the location of its transmission and distributing systems and shall file a stipulation as follows:

(1) Every contract with purchasers of energy shall provide that the price, terms and conditions affecting price and duration shall be subject to revision by the commission upon complaint or upon motion of the commission, any ruling of the commission to be subject to judicial review.

(2) That charges for all of the service and customers shall not, on the average, exceed $19 per hp sold, but this shall not prevent the commission from requiring a lower price for particular kinds of service from that which the applicant may establish upon finding after hearing that the price charged is unjust, unreasonable or otherwise in violation of the public service commissions law. Such ruling shall be subject to judicial review.

(3) Until further order of the commission the company shall reserve at least 23,000 electric hp for sale to consumers of energy for light or power.

(4) Upon merger of the two companies the stock, bonds and floating debt of the Niagara Falls Electrical Transmission Company and the third mortgage bonds, floating debt and $92,000 first consolidated mortgage bonds of the Niagara Falls Gas & Electric Light Company shall be canceled.

In regard to the continued exportation of electricity from Canada the commission says it must assume that relations between the United States and Canada, affecting the means of continuing great industries which have grown up in reliance upon the use of electric power imported from Canada, and also the interests of the Canadian electric producing companies themselves, have become fixed and subject only to such changes as will protect the great commercial and industrial interests and rights now served by electrical power brought from Canada. This is particularly so in this case as it appears that the percentage of export power to plant capacity is the same as has been and is allowed by Canada to other exporting electrical companies. Discrimination in prices charged by Canadian electrical producing companies whereby Canadian purchasers are favored to the prejudice of American customers, and the existing shortage of electrical power on the Niagara frontier, are discussed in the opinion. It is declared that the various contracts with the producing companies should be revised as to prices charged American distributing companies, that there is a large shortage of electrical power in western New York with a strong demand for greater supply which is not being met by existing companies, and that the contracts mentioned tend to perpetuate high rates to consumers.

The commission points out that the Hydro-Electric Commission of Canada has contracted for electricity delivered at a Canadian producing plant for $9 per hp in large quantity, while the charge for Canadian electric energy to the American company for a large amount of power is $12.50 per hp.

The opinion states that it was not good policy for New York companies at the outset to take on these contracts at prices so high as to compel in a city like Buffalo, 25 or 30 miles from the Canadian line, an intermediate company to pay so much as $16 per hp to supply part of the power users in Buffalo, and to make the Buffalo General Electric Company pay about $25 for such energy and base its prices to the public thereon. The Buffalo electric power situation resulted largely from the old practice of forming numerous companies with almost unlimited power of capitalization to do a limited business within a limited territory. As a whole, the Buffalo and Niagara frontier electrical development from Niagara power, because unregulated at the outset and practically not regulated at all until 1905, has been an economic disappointment.

The commission states that the financial and corporation methods employed have been followed with high rates to the public at large; that the price for Canadian power to the American company seems fixed only at such figure as the American company can accept and do business upon; that the Cataract company has no true economic place in Buffalo, and that the Buffalo General Electric Company or some other corporation should be the sole distributing company; that the Niagara Falls Power Company, both Canadian and American, should sell power to that company at the lowest price consistent with expense and investment and maintenance, and that the power concerned in this contract should be sold to the Buffalo distributing company, and in such sale there should be no need for the formation and operation of the Canadian-American Power Corporation; that the contract under consideration should be revised so that the price at the Electrical Development Company's busbars shall be the same as the price charged there for a like quantity of power used in Canada; that if there shall not be a general change soon in the price generally paid to producing companies by distributing companies in and about the Niagara frontier, the interposition of the United States and State governments may be confidently expected.

The commission, says, however, that in saying this contract price and other similar contract prices in Buffalo and vicinity are unsatisfactory it must deal with the situation that has been forced by the formation of companies and issuance of securities and the making of contracts before this law became effective. So far as it is advised, the existing contracts are legal and enforcible.

Capitalization of a contract for the furnishing of electrical horse-power whereby stock would be issued to represent all estimated available profits from the distribution and sale of such power is condemned by the commission as a practice, and in this case it is not indorsed. The commission reaffirms its decision in the Cataract Power & Conduit Company case and distinguishes that case as a rate case, while this involves the issuance of stock for the purpose of engaging in business. The contract in question is a desirable contract which, if acquired on a reasonable basis, will in the sale of electrical power under it benefit the people in that section of the State.

Commissioner Sague filed a dissenting opinion.

Current News Notes

Roosting Birds Dim Broadway Signs.—During the cold weather which descended on New York City in the latter part of February the appearance of some of the electric signs in the Times Square theater section was interfered with by the hundreds of birds which nestled near the lamps to get such warmth and comfort as the bottled incandescent filaments afforded. Sparrows and pigeons were reported to be the worst offenders.

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Public Service Commission Wanted in Kentucky.—A resolution has been put before the lower house of the Kentucky Legislature providing for the appointment of a commission of three to draft a measure creating a public utilities commission to be presented to the 1916 Legislature, the speaker of the House to name one member of the first-named commission, the president of the Senate to name another, and the two thus named to name the third.

* * *

Annual Concert of Commonwealth Edison Orchestra.—The second annual concert of the Commonwealth Edison Orchestra in Orchestra Hall, Chicago, on Feb. 12, was both an artistic and a social success. The opening feature of the program was a grand selection from Wagner's "Tannhäuser," and the music throughout was of high class and most acceptably given. Luella Chilson Ohrman, soprano soloist, assisted the orchestra. Mr. Morgan L. Eastman was the conductor. To him is due much of the credit for the exceptional success of the organization.

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Operation of Induction Motors.—On page 303 of the *Electrical World* for Feb. 7, 1914, in the report of the discussion of a paper by Mr. K. W. Adkins, Mr. F. A. Barron was reported to have stated that the amount of overfusing of induction motors varies from about four times the rated motor current in 1-hp sizes to about twice the current in large sizes. The values given should have been about two and one-half times rated full-load current for motors up to 7.5 hp; twice full-load current for motors rated at from 8 hp to 35 hp, and from one and three-quarters to one and one-half times full-load current for motors of from 40 hp to 200 hp.

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Attorney-General Seeks to Revoke Five Claims on Nooksack River, Washington.—The United States Attorney-General has filed suit through the local district attorney's office at Seattle, Wash., against the Puget Sound Traction, Light & Power Company for the revocation of five claims on the Nooksack River, near Bellingham, Wash., where the company has a two-million-dollar power plant. It is charged in the complaint that the patents to the claims were obtained through fraud and misrepresentation, the government alleging that the claims were filed by Messrs. P. D. Cornwall, a San Francisco capitalist; Alvinza Hayward, and others, in 1902, and that Cornwall obtained deeds to the claims from the other interested parties and later made application for patents.

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SOCIETY MEETINGS

Railroad Engineers' Convention.—The American Railway Engineering Association will hold its annual convention at the Congress Hotel, Chicago, on March 17 to March 20 inclusive. The office of the association is at 910 South Michigan Avenue, Chicago, and Mr. E. D. Fritch is secretary. During the convention there will be the usual exhibit of railroad appliances in the Coliseum.

Radium and Its Phenomena.—Dr. Patrick S. O'Donnell delivered an illustrated lecture on radium before the Western Society of Engineers, Chicago, on Feb. 16, and with 5 milligrams of radium bromide performed several experiments to show how radium ionizes the surrounding air, making it a conductor of electricity. In the discussion Dr. J. Rawson Pennington reviewed the history of the science of radioactivity.

* * *

National Efficiency Exposition and Conference.—The first National Efficiency Exposition and Conference will be held in New York City, April 4 to 11, at the Grand Central Palace. This purpose of this exposition is to direct attention to everything that makes for the saving of time and labor, consequently introducing new mechanical devices and displaying those already employed. At the conference discussions will relate to how efficiency may be attained. Mr. Walter H. Tallis, exposition director, has offices at 41 Park Row, New York.

* * *

Officers of Electrical League of Cleveland.—At a recent meeting of the Electrical League of Cleveland, Ohio, the following officers were elected for 1914: President, Mr. George S. Milnes, Erner Electric Company; first vice-president, Mr. M. H. Moffett, National Carbon Company; second vice-president, Mr. F. M. Grant, Harrington & Grant; third vice-president, Mr. J. T. Kermode, Cleveland Electric Illuminating Company; fourth vice-president, Mr. N. H. Boynton, National Lamp Works; secretary-treasurer, Mr. R. G. Pate; trustees (two years), Messrs. Harry Swindell, A. E. Bering, H. B. Gay and M. E. Turner.

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Boost Electric Truck, Says Mr. Street.—At a meeting of the Chicago Jovian League on March 2 Mr. C. A. Street, general sales manager of the Walker Vehicle Company, discussed commercial electric vehicles. Mr. Street asked all his hearers to boost the electric vehicle. It has been shown, he said, that the electric truck or delivery wagon is more economical than either the horse-drawn or the gasoline vehicle for perhaps 75 per cent of city haulage. The manufacturers of storage batteries are making tremendous strides in reducing the weights of vehicle batteries. Mr. Street presented a number of arguments in favor of the use of electric wagons and made the interesting statement that Marshall Field & Company, of Chicago, hold the "world's record" as the owners and operators of the largest number of electric vehicles in one city.

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Gas, Electric and Street Railway Association of Oklahoma.—The Gas, Electric and Street Railway Association of Oklahoma will hold its 1914 convention at the Lee-Huckins Hotel, Oklahoma City, May 13, 14 and 15. The Oklahoma meeting will precede by a week the convention of the Southwestern Electric and Gas Association at Galveston, Tex., thus enabling out-of-state visitors to attend both meetings. Among the papers to be presented at the Oklahoma convention are the following: "Results of Prepayment Features in Car Design," by Mr. J. J. Johnson; "Motor Drive," by Prof. A. P. Little; "The Grounding of Secondaries," by Mr. Burton French, engineer for the Public Service Company of Oklahoma; "Commission Order No. 774, Relating to the Filing of Profiles and Plan Drawings by Public Utility Corporations," by Mr. George A. Henshaw, member of the Oklahoma Corporation Commission, and "Central Station Rates," by Mr. W. J. Norton, formerly secretary of the rate-research committee of the National Electric Light Association. Prof. Harold V. Bozell, Norman, Okla., is secretary-treasurer of the association.

Electrical Distribution Engineering in Chicago—I

Design, construction and operating methods of the Commonwealth Edison Company in its transmission, substation and distribution departments—Work of inspection and repair

APPROXIMATELY 400 employees are required to perform the tasks in connection with the production and distribution of the output of the Commonwealth Edison Company's Chicago power plants, which have an aggregate rating of a third of a million horse-power. Of these employees the larger part are occupied directly or indirectly in distribution work, and a considerable portion of those are in the engineering departments.

Some idea of the magnitude of the engineering problems of design, construction and maintenance continuously confronting the engineering departments is afforded by an examination of the rate of growth of the local service requirements. Within ten years practically all of the present business has been built up, and during the past year service connections were made at an average rate of two per hour, night and day. Poles are being set at the rate of 9000 per year and line transformer rating is increasing by about 13,000 kw annually. Power plant and substation equipment is being expanded with corresponding rapidity.

As the load increases in different parts of the system and in different classes of service, not only must the lines be extended but existing cables and pole lines must have their loads redistributed so that there may be neither overloading nor excessive line drop.

The following paragraphs give in some detail the plans successfully developed by the Commonwealth Edison Company for coping with the rapid growth of the business.

Organization of Staff

The engineering work divides itself naturally into two parts, one involving mainly design, supervision of construction, and testing; the other, principally operating. These are known as the engineering and operating departments respectively. While a sharp dividing line between two such departments is not possible in general, it may be said that the engineering department determines standards of construction in general, supervises part of the actual construction, lays out the transmission and distribution system and changes it to meet changing service conditions, and designs both substations and the electrical features of power plants. The mechanical engineering of power plants is done by

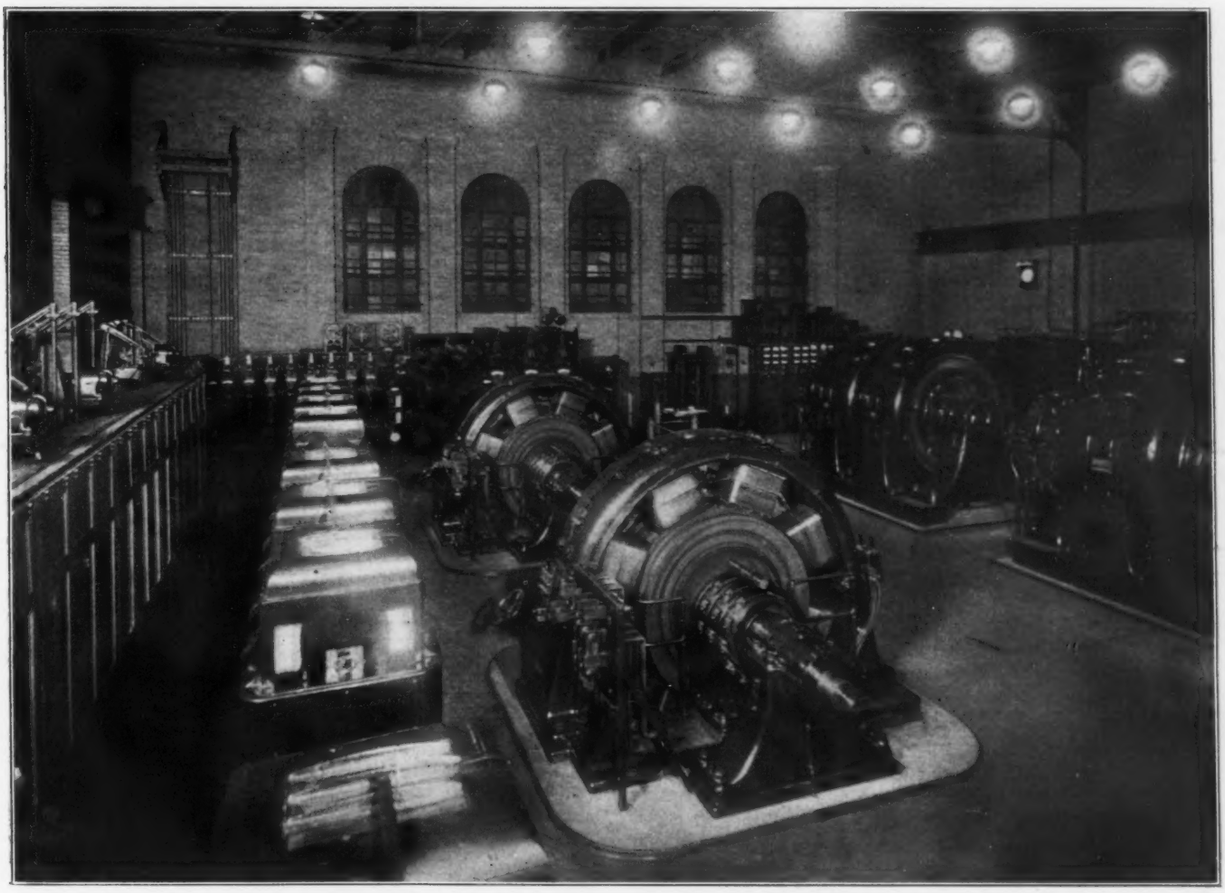


FIG. 1—INTERIOR OF SOUTH CHICAGO SUBSTATION, COMMONWEALTH EDISON COMPANY

the company's consulting engineers, Sargent & Lundy. The operating department, in addition to the large duty of operating all equipment, does all construction on transmission and distribution systems, excepting conduit for which the expenditure exceeds $2,000. Mr. W. L. Abbott is chief operating engineer and his assistant is Mr. D. W. Roper. The electrical engineer is Mr. R.

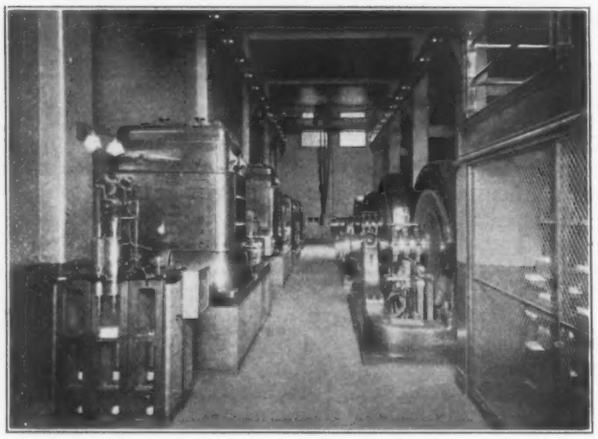


FIG. 2—INTERIOR OF MARKET STREET SUBSTATION

F. Schuchardt, with whom is associated Mr. H. B. Gear in charge of distribution.

The great power plants and many of the substations of the company have been fully described in previous issues of the *Electrical World*. The power-plant operation is directed by three chief engineers, one for the Fisk and Quarry Street stations, one for Northwest station, and one for the elevated-railway plants recently acquired. The fuel supply is purchased by the fuel agent under the general direction of the chief operating engineer. It is tested by the chemist of the testing department. The operation of the substations is under the direction of a superintendent, Mr. E. F. Smith, who has made a special study of the training and discipline of employees, with a view to maintaining a high degree of operating efficiency in the widely scattered forces under his control. The battery plant, comprising a large number of batteries, is looked after by a superintendent of batteries in close co-operation with the substation department.

To illustrate the way in which the work divides itself, the activities of a few of the more conspicuous divisions of the company will be given in some detail. The street department has charge of the maintenance of conduits and cable and overhead construction, makes all service connections and does considerable construction work. A large group of employees is engaged in making repairs to customers' equipment, installing and removing meters and taking care of inside troubles. Sixty or seventy men are required for this service. Nearly 200 more are necessary in the meter department, where meter stock is maintained and customers' meters are read, tested and repaired. A small but most vital section of the operating department's work is that of the load dispatcher, whose work was fully discussed in these columns, Sept. 27, 1913.

The distribution work of the engineering department is divided into a number of sections, the titles of which indicate their functions. Each engineer of one of these has a corps of assistants numbering up to thirty men as required. The engineers of underground and overhead lines respectively attend to design and construction, and a civil engineer connected with these subdivisions gives special attention to contracts for conduit and tunnel construction. Inspection of new construction and of present condition of lines and auxiliaries requires a large corps, as does also the clerical work of making records of orders, transformer changes, etc. A pressure-maintenance division is occupied in reading recording voltmeters placed at various points in the system and in planning rearrangement of feeders to meet load requirements from the regulation standpoint. A map-record division is constantly occupied in preparing proper records of all changes in the distribution system which are made from preliminary sketches furnished by the engineer of overhead and underground line extensions.

In a system such as this, having so many and diverse lines of work and so many new problems constantly arising, a flexible organization is required. While each individual knows what his duties are and to whom he is responsible, there is constant adjustment of duties and shifting of individuals to secure the best possible adaptation of men to tasks.

Construction Methods

Projects for new distribution construction originate in a "street investment committee," consisting of representatives of all departments concerned. All overhead, conduit and other construction is performed according to rigid specifications, the standards being revised from year to year. Conduit specifications agree with those of the Board of Supervising Engineers, Chicago Traction, and the National Electric Light Association. Both tile and stone conduit are

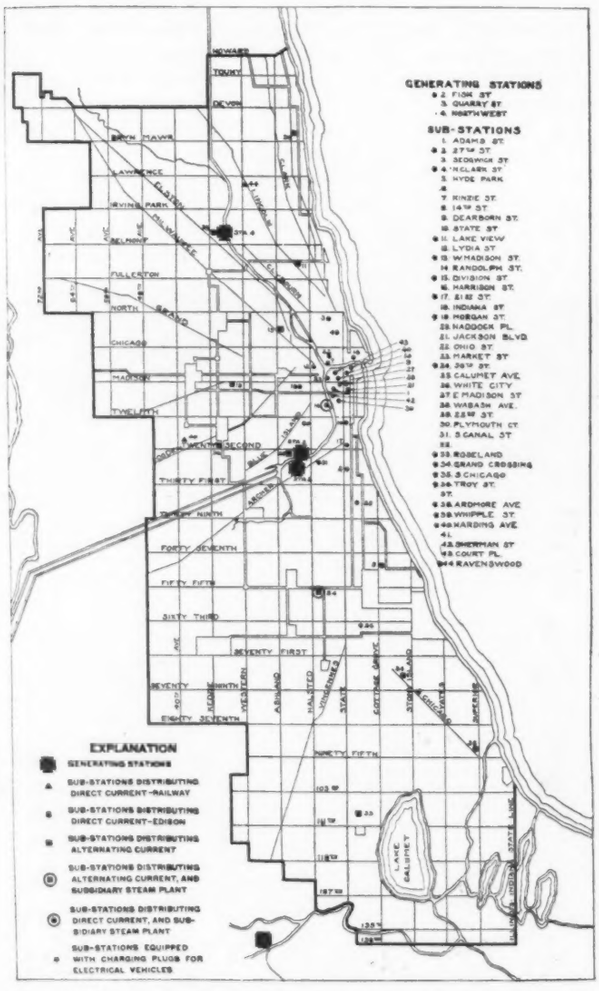


FIG. 3—MAP SHOWING POWER PLANT AND SUBSTATIONS

used. With the former the ducts are laid as close together as possible and the joints and triangular spaces are filled with one-to-three cement mortar. Ducts of stone conduit are separated horizontally and vertically by 1-in. spaces filled with fine concrete. All conduit is surrounded with 3 in. of concrete and laid in general on a grade of 1.5 in. per 100 ft.

Manholes are built of sewer brick laid in one-to-three cement mortar with rigid requirements as to wetting the brick before laying in hot weather and heating of sand and water in freezing weather. The manhole floors are of 4-in. concrete and the roofs of 8-in. concrete in all cases. Typical manhole layouts are shown in the accompanying figures.

On account of the necessity for crossing the Chicago River in many places tunnels form an important feature of underground construction. There are now nine tunnels in use averaging about 400 ft. in length, and they are being built at a rate of one per year. They are used in place of submarine cables, on account of their greater reliability, wherever the number of cables is sufficiently large to warrant the expense. The design of these tunnels falls to the civil engineer, but, as in the case of the conduits, he consults all departments

FIG. 4—CALUMET AVENUE SUBSTATION

concerned. In fact, a committee of representatives from all such departments goes over the plans. The recommendations of this committee go to the street investment committee, which finally decides upon the practicability of any construction proposition. While each tunnel presents its own construction problems, the general plan consists in sinking a circular vertical shaft at each end to a depth depending upon the nature of the ground, a hard clay being desired if it can be found. The shafts are about 8 ft. in diameter and they are lined, like the tunnels, with concrete. The tunnels are about 6 ft. by 7 ft. inside, with vertical walls and circular-arch roofs. Conduits are provided for the electric cables in shafts and tunnels.

Use of Underground Cables

The requirements of the various classes of service are such that it is necessary to use a large number of cable sizes. This cable is practically all paper-insulated. For the twenty-five-cycle railway work three-conductor cable is used in four sizes—300,000 and 250,000 circ. mil and No. 0000 for 9000-volt service and No. 00 for 20,000-volt service. In the sixty-cycle lines four-conductor No. 0 and single-conductor Nos. 0 and 6 are standard. The direct-current needs are various, necessitating keeping in stock single-conductor cables of 2,000,000, 1,500,000, 1,000,000, 750,000, 500,000 and 350,000-circ. mil area in addition to No. 0000. Very occasionally 1,000,000-circ. mil concentric cable is also used. No. 14 three-conductor pressure cable is used for connecting all feeder ends with the switchboard nearest to them.

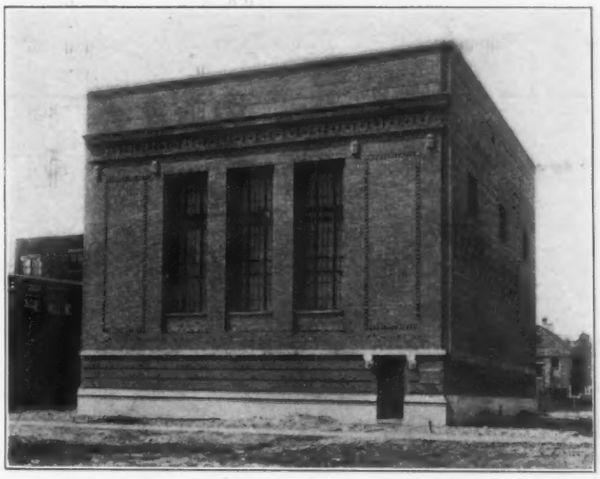


FIG. 5—HARDING AVENUE SUBSTATION

The consumption of cable is shown by Table I, on the following page.

On all large jobs, such as transmission-line and sixty-cycle feeders, cables are ordered in individual lengths. A list of the required lengths is sent to the factory, and reels come suitably marked. A large spare stock is always maintained, and this may contain a total of 100,000 ft. or more of standard sizes.

The design features of cables and specifications for their installation are in the hands of the distribution engineer, Mr. H. B. Gear. In his office such matters as the types of cable to be employed and the loading to be allowed are decided. The investment in cables is so great that the utmost care is taken to insure them against overloading. The operating department pulls

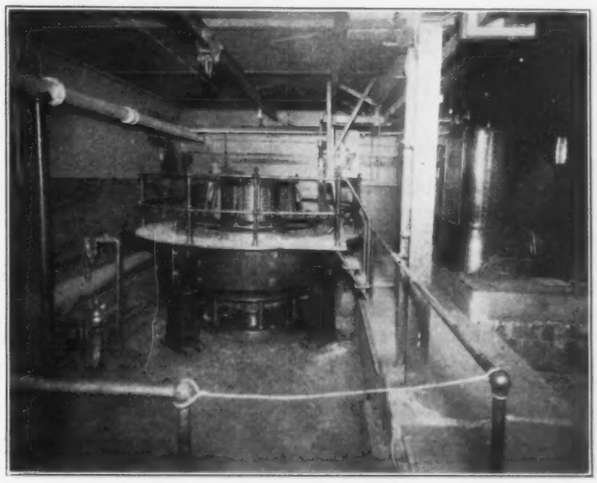


FIG. 6—VERTICAL ROTARY CONVERTER IN RANDOLPH STREET SUBSTATION

in the cables and connects them up, and finally they are tested out by the testing department before being put into service.

All overhead construction work is done by the company under specifications recently revised. Approximately 75 per cent of the pole line is occupied jointly

with the telephone company. The overhead transmission comprises 20,000-volt, sixty-cycle, 12,000-volt, sixty-cycle, and 9000-volt, twenty-five-cycle lines. There is also a large amount of 4000-volt, four-wire, three-phase distribution line with grounded neutral. Most of the pole line is single-circuit line. In all, more than

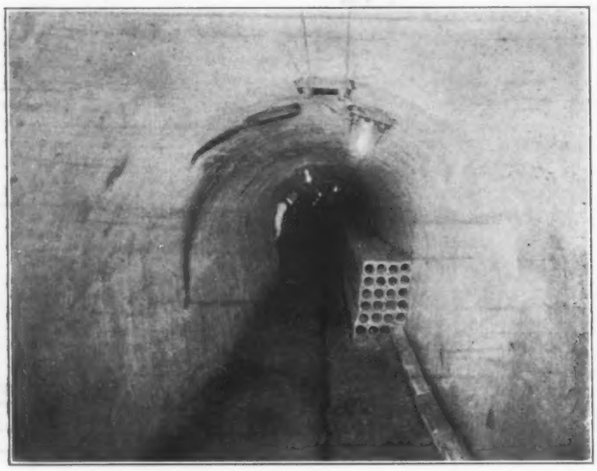


FIG. 7—WASHINGTON STREET TUNNEL UNDER CHICAGO RIVER

8000 miles of wire is required in these lines. This is largely of No. 6 section, but there were about 300 miles of No. 0000 wire up to the close of 1912. This wire is mounted on both porcelain and glass insulators, the former being used for high-tension and the latter for low-tension lines. In making taps triple-groove glass insulators mounted on buck arms are employed.

In pole-line construction nothing but Northern white cedar is used. The standard pole is 40 ft. in length and has a 7-in. top. Tree trimming along the pole line is

TABLE I—CABLE CONSUMPTION FOR 1910 AND FOR THE FIVE YEARS FROM 1908 TO 1912 INCLUSIVE

	Lb. Copper
1900	109,474
1908	1,088,336
1909	2,328,153
1910	1,719,474
1911	1,187,185
1912	1,355,032

done by professional trimmers, frequently men who have done similar work for the city, and in this way a common source of complaint is avoided. About seventeen construction gangs, with wagons, averaging eight men and a foreman each, are employed in the heavy work of pole setting, wire stringing, etc. In addition, there are fifteen gangs averaging four each, engaged in making service connections and placing transformers. Large jobs are frequent owing to the taking on of large customers, as is evident from the statement that customers requiring banks of three 50-kw transformers are secured at an average rate of one per month. The largest of the recent large line constructions is a 12-mile, 20,000-volt line from South Chicago to Blue Island to supply energy to the cement mills at Buffington.

For the making of service connections, now numbering over 18,000 per year, the city is divided into three districts, each with an office manned by a general foreman and a force of clerks. The gangs and their foreman report on their jobs, where they receive instructions on printed forms which are also used as reports to economize labor in writing.

In the service and repair work use is made of a special design of electric truck of which the company has now a dozen. This truck is a veritable supply store and its contents are accessible from outside through doors which let down at the sides. The truck is made by the Walker Vehicle Company at its Chicago factory and was exhibited at the National Electric Light Association convention.

Keeping track of new line construction and repairs in such an extensive system as this requires unusual methods. One plan used involves a large routing map mounted on the wall in the central office. On this chart service orders are recorded by means of tacks with heads of different colors for different days. The tacks are connected by strings showing progress from day to day, strings of different colors being used to designate different gangs. Two route clerks are engaged in keeping track of the work, and they change the strings daily, laying out the route of the work as modified by conditions existing at the different jobs. Repair orders are followed on the same map by means of seals of colors corresponding to the tack heads.

An excellent idea of the development of the line work of the company can be gathered from the statement that the new business has required an increase in transformer equipment amounting lately to more than 1200

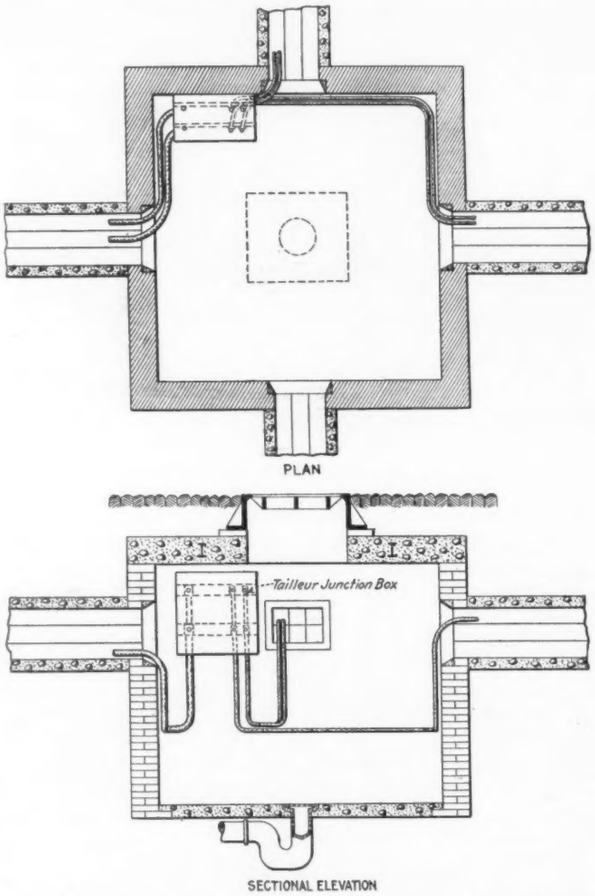


FIG. 8—TYPICAL MANHOLE CONSTRUCTION FOR LOW-TENSION DISTRIBUTION

a year. Table II gives data showing the recent growth of this equipment.

Engineering Features of Line Operation

In a plant of this kind plans must be kept well ahead of requirements. With the rapidly growing load annual revision of the distribution of the load on the lines is

necessary. Revision is made on the basis of voltage fluctuation and of loading. The division of voltage maintenance is constantly testing for line drop by means of sixty recording voltmeters placed near the centers of circuits. Causes of fluctuations are studied and the necessary changes in lines are recommended. The maximum fluctuation allowed at distribution centers is from 117 volts to 114 volts, although in outlying districts the range may be a volt more either way. The intention is to deliver to the most remote customer a pressure of 113 volts.

TABLE II—LINE TRANSFORMERS IN OPERATION

Year	Number	Rating, Kw
1909	8,123	62,771
1910	9,556	76,547
1911	10,776	88,985
1912	11,972	101,959

During the present year there have been seventy-nine sixty-cycle circuits in operation. Of these sixty have been revised, the largest revision in the company's history. This was made necessary by the 18,000 overhead services installed last year.

All transmission lines so far have been operated without parallel connection owing to the danger of heavy short-circuits in case of cable trouble. It is expected that shortly the reverse-power relay will be developed to a point to permit cable operation in parallel. Until last year it was standard to limit the rotary capacity on any section of station or substation bus to 2000 kw and to assign a transmission line to each section. This practice was based on the assumption that the rotaries could safely carry 50 per cent overload and that a No. 0000 cable could carry 3500 kw at 9000 volts. This was standard practice all over the country a few years ago. Until recently 2000-kw rotaries were standard, but lately the size has been increased to 3500 kw for lighting and 4000 kw for railway substations. As high as 4500 kw per bus has been used on the sixty-cycle lines. The standard lighting cable has therefore been increased to 250,000 circ. mil and the railway cable to 300,000 circ. mil. This is the limit for a 3.5-in. duct with 350-ft. or 400-ft. draw. The railways used proportionately larger cables as, owing to the fluctuating nature of the load, railway cables are more apt to be overloaded.

The company is looking forward to parallel operation as the next step. In the "Loop" district there is already a 28,000-kw load. With the subdivision into several units as at present a cable capacity of 42,000 kw is necessary, allowing a 50 per cent reserve. The best that could possibly be done with individual operation in any case would be one reserve cable for three substations, say 15 per cent reserve. Parallel operation will permit a more efficient use of copper. It is the live problem in underground transmission.

The loading of lines is ascertained from weekly reports furnished from all substations showing the maximum loads on every feeder and the times when these occurred. On the basis of these and the voltage records the engineering department specifies on Jan. 1 of each year what circuit revision work is necessary. New maps showing changes are made, a diagram in standard form being made for each change. The general maps are revised as soon as the changes have been made. When changes have been made the street department notifies all departments concerned and especially the load dispatcher, so that they will know of new cable cut in and of the condition of all cables. Two men are constantly engaged in private right-of-way work, so that routes for necessary lines may be available when required.

The matter of safety has been already mentioned. Rules are useless unless understood and enforced. To insure intelligent compliance the general foremen hold weekly meetings with one of the superintendents, and together they form an overhead-line examining board. They examine the men on safety matters and on their understanding of the proper way of doing line work—that is, making joints, cutting-in transformers, etc.—without interfering unnecessarily with service and with the elimination of the element of danger. Outside foremen and linemen are all examined at least once a year and some are up for this purpose every week. While engaged in this work the examining board also considers methods of making repairs and reports recommendations to Mr. D. W. Roper, assistant to the chief operating engineer. The close co-operation secured by these weekly meetings insures progress in method and spirit. The chairman of the board is the engineer of the street department, Mr. A. Balsley. He follows out the recommendations of the board and keeps in close touch with the work of all of the foremen who compose it.

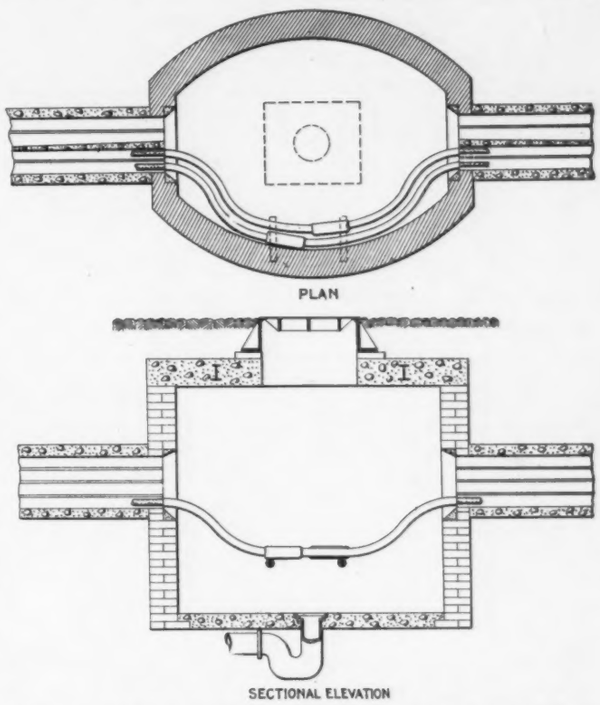


FIG. 9—TYPICAL MANHOLE FOR HIGH-TENSION DISTRIBUTION

In connection with line operation studies are being made in the hope that definite conclusions can be reached later as to the best means to be used for protecting apparatus from lightning. Eight of the circuits have been equipped with lightning arresters on every transformer pole. The transformers on eight other circuits have been replaced by others having submerged terminal boards or no terminal boards at all, as arcs across terminal boards have been found to give considerable trouble.

In a later issue of the *Electrical World* there will be given descriptions of substation and battery equipments and accounts of the inspection and repair of cables and pole lines, the prevention of electrolysis, and operating methods.

Meeting of American Institute of Electrical Engineers

Papers dealing with generation, transmission and distribution of electrical energy, protective apparatus and economics of power-house design, and discussion incident thereto

IN last week's issue of the *Electrical World* was published an account of the first day's session of the second midwinter convention of the A. I. E. E., including reports on engineering data and the feasibility of an A. I. E. E. handbook, and papers on protective reactances and indoor and outdoor substations. This week's account covers the proceedings of Feb. 26 and 27, and of a publicity meeting on the evening of Feb. 25.

I. E. C. Publicity Meeting

On Wednesday evening, in the auditorium of the Engineering Societies Building, a publicity meeting to stimulate interest in the International Electrical Congress, San Francisco, 1915, was held under the auspices of the Congress committee on organization. The addresses touched particularly upon the popular and more interesting phases of the forthcoming Congress, the Panama-Pacific Exposition, and the trip to San Francisco, and were illustrated with lantern slides and moving pictures.

Dr. C. P. Steinmetz, Schenectady, N. Y., honorary president of the 1915 congress, recounted briefly the achievements of past electrical congresses in acquainting the engineers of one nation with the methods and practices of others, often so radically different. Each international electrical congress, declared Dr. Steinmetz, has marked some great step in electrical engineering, and he predicted that the 1915 meeting will witness the inauguration of interstate and international transmission networks paralleling the railways and transporting energy developed at one point for consumption in other centers.

Dr. William Rader, Pottstown, Pa., presented an illustrated address on the Panama-Pacific International Exposition, and Mr. W. D'A. Ryan, Schenectady, N. Y., described the plans for lighting the grounds, buildings and interior exhibition spaces of the exposition, for which he is illuminating engineer.

Mr. J. A. Cruikshank, New York, gave an illustrated lecture on scenic features of the trip across the continent, and Mr. Paul M. Lincoln, Pittsburgh, Pa., reviewed briefly the principal electrical developments of the United States.

Problems of High-Tension Transmission Lines

Some important problems which have to be considered when building and operating high-voltage lines were pointed out in the report of Mr. P. W. Sothman, chairman of the sub-committee on transmission. Routes crossing streams or mountain ranges and passing through districts frequented by lightning storms should be particulary avoided. Short cuts may be made across cultivated land, but it is preferable to follow highways, steam or electric rights-of-way, etc., to facilitate patrolling. The author emphasized the need of having the A. I. E. E. adopt specifications for line cross-overs. Factors determining the type of towers to be employed were enumerated and the square or four-legged type was pointed out as being generally more economical to construct than the three-legged type. Companies should proceed with caution when considering the adoption of flexible towers. Where transmission lines are liable to be coated with ice or snow, it is not advisable to support the conductors in a vertical plane as they may come in contact with each other. In the East ice has been observed to collect mainly at the center of wire spans; therefore conductors should be designed with this in view. The method of designing towers should be standardized, so that instead of its being necessary to order special-design towers it will be possible to obtain orders immediately by specifying a certain loading. Recommendations were also made on the strength of material required in towers and the minimum degree of disturbance to allow for. Erecting towers by tilting them into place sometimes weakens them; therefore a final inspection should be made after installation. Galvanizing of towers, because of its durability, is usually preferred to painting, but the latter, if done periodically, affords good protection. Hard-drawn copper cables should not have hemp centers, as a semi-chemical and mechanical action usually sets in, weakening the strands. It is reported that aluminum cables with steel cores are not considered satisfactory by English manufacturers, for similar reasons. The report suggested that a set of curves be evolved, based preferably on the catenary, from which sags can be quickly and accurately determined. While overhead ground wires generally afford protection against lightning, the reports of damage on protected and unprotected lines make this a much-mooted question. The experience of several companies with disk-type suspension insulators failing after being in service a year or two is probably due to aging of the porcelain from electrical fatigue. For equalizing the potential gradient over suspension insulators on lines carrying 110,000 volts or higher, shields may be used on the end units, but this practice is not necessary at lower voltages. Attention was called to the neglect of designing line clamps with smooth outlines to reduce the surrounding electrostatic field. The improved results obtained with transformers designed to withstand severe disturbances show the advisability of strengthening apparatus rather than installing devices to protect it. Most of the telephone disturbances now experienced are caused by poor insulation. The report closed with a description of a method of eliminating disturbance on a transmitting company's telephone line. Abstracts of the four appendixes to the transmission sub-committee's report follow:

Deterioration of Porcelain Insulators in Service

In his appendix to the sub-committee's report on transmission Mr. J. A. Brundige said that engineers are beginning to believe that a large number of porcelain and glass-insulator failures can be attributed to electrical fatigue just as with rubber and compound-treated fabrics. While the cause of the fatigue is uncertain, evidence seems to point to transient overvoltages. It is possible to obtain high dielectric strength and toughness, the two principal requisites of insulators, if the porcelain is fired properly. Insulators must be designed to withstand temperature changes

and prevent flash-overs, or failures may ensue in spite of high dielectric strength if the outline is not smooth. A good test for revealing minute cracks in insulators is to draw a line of ink across the surface of the insulator. The ink will be drawn by capillary attraction along the cracks, if any are present. A high-range megger is recommended for locating insulator faults which cannot be discovered by any other means. A boiling-water test for ascertaining the ability of an insulator on a pin to withstand temperature change was described. Enough data are now available, it is declared, to design insulators properly so that less trouble will be experienced with them in the future.

Radius of Influence of a Direct Lightning Stroke

Through a continued personal inquiry the author of this report, Mr. L. C. Nicholson, has obtained an estimate of the radius of influence of direct lightning strokes. His paper pointed out that it is doubtful if any insulator in use at the present time will withstand a direct lightning stroke on the line, whether the latter is equipped with protective devices or not. Observations show that some lightning strokes have a diameter of about 20 ft., showing that a single ground wire cannot be expected to intercept a direct stroke. Extended observations on lines supported by 60,000-volt pin-type insulators and unprotected by ground wires led to the estimate that the radial influence due to induction from lightning is rarely in excess of 2000 ft. The extent of radial influence is probably proportional to the energy dissipated in the lightning stroke. Better insulated lines are not so easily affected by induction. In New York about 10 per cent of all 60,000-volt line disturbances from lightning are caused by direct strokes.

Transmission-Line Problems in the West

Conditions met with near the San Antonio Light & Power Company's transmission system in southern California were brought out in Mr. P. M. Downing's appendix to the sub-committee report. The company, which had a pioneer 10,000-volt transmission, originally employed ten 1000-volt transformers because higher-voltage units were not available at that time. Snow and lightning do not have to be contended with generally in that locality, so that protective devices are not usually installed, a horn-gap arrester being satisfactory in most cases. During the dry seasons, however, salt sea fog condenses on the insulators and leakage sometimes causes the pole and conductors to burn off. Cleaning the insulators improves conditions and the rains during the wet season help considerably in removing the deposit. Trouble due to this leakage is prevented most effectively by tying the pins together electrically. They are not grounded as this might cause arcs to be established between the conductors and ground.

Regulation of voltage is secured by floating synchronous condensers on the line at important distributing centers. Automatic outdoor oil switches are used quite extensively on the branch circuits and for sectionalizing trunk lines. The trip relays are connected in series with the main line, to avoid the use of current relays. The author pointed out the fact that manufacturers have failed to support transformer windings sufficiently to prevent distortion when short-circuits occur. Instead of using vertical spacers between transformer coils, he recommended employing short strips placed diagonally across the coils, or wave-shaped strips which will allow free oil circulation and also support the coils.

Switching

The conditions under which high-tension switching will produce the greatest disturbances were brought out in the appendix by Mr. G. Faccioli. Two of the most undesirable conditions are to connect a dead line at zero potential to another alternating-current circuit when the instantaneous emf in the latter is passing through its maximum value, and to disconnect a short-circuited line from a supply source when the instantaneous current is at its maximum value.

Oscillations may occur between inductance and capacity massed at separate points or distributed along the circuits. If switching is accompanied by arcing, the potential rise may become dangerous, as the oscillations sent out may strike a localized oscillatory circuit having the same natural frequency. High-tension switching should therefore be done judiciously, and then only when special precautions are taken to avoid disturbances. The blowing of fuses is accompanied by similar but more exaggerated disturbances as fuses usually open under load. Low-tension switching is considered preferable to high-tension operation.

Practical Operation of Suspension Insulators

In the paper by Mr. H. W. Buck it was pointed out that unlimited deflection of suspension insulators requires large conductor clearances and consequently more expensive towers. By attaching auxiliary weights to the insulators and by employing the proper-size conductor, insulator deflection may be minimized. A table accompanying the paper indicates the size of conductor and auxiliary weight to use for definite wind pressures and deflections. Insulators should be counterweighted, especially when supporting aluminum cables, as the latter are light and expose relatively large areas to wind pressure. Use of weights on insulators also equalizes the slack in cables which might cause a short-circuit if allowed to become excessive especially when the conductors are arranged in a vertical plane. The whipping action caused in cable transmission lines when a span is struck by a sudden gust of wind may be minimized by installing dead-end insulators at frequent intervals. Ballast weights are also advantageous on these insulators in preventing side-swing of jumper connections, but the latter should be designed to allow lateral movement. Other suggestions made in the paper were that considerable clearance be permitted between the over-

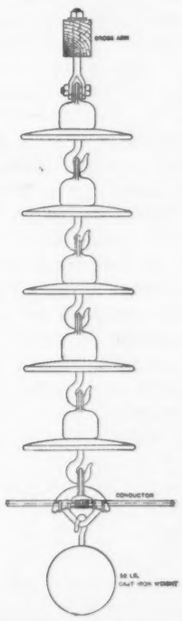


FIG. 1—BALLAST WEIGHT FOR TRANSMISSION-LINE INSULATORS

head ground line and the conductors, but that too much should not be allowed between the latter.

Discussion

In opening the discussion on Mr. Sothman's paper, Chairman Rushmore made the comment that insulator design has now reached a point where exact mathematical methods must be applied. Mr. H. W. Buck, New York, referred to the fact that exact scientific considerations are sometimes neglected when meeting the practical conditions of field erection and he recommended that specifications in design consider the problems of the construction crew.

Mr. F. W. Peek, Jr., Schenectady, N. Y., enumerated the factors of energy, wave-shape, time-element, voltage, etc., necessary for a study of transmission-line phenomena. To illustrate the significance of the "time element" of a spark-gap, the speaker showed that if two gaps be connected in parallel the one having the smallest time-element will be bridged in spite of the reduced sparking distance of the other gap.

Mr. C. E. Waddell, Asheville, N. C., recommended the method of obtaining easements in securing rights-of-way for transmission lines as being preferable to outright purchases. Wider routes are usually thus secured more cheaply, the agreement often including a proviso for the cutting of the timber back from the property line. For transmission lines of 70,000 volts and under, Mr. Waddell expressed a leaning back toward wood-pole construction with non-grounded fittings. In the case of a certain steel-tower line which parallels a wooden-pole circuit, Mr. Waddell said that the tower line has shown innumerable interruptions, while the wooden-pole circuit has been without a single accident. He suggested that suspension-type insulators be pivoted with a hinge permitting them to swing freely in the direction of the conductors but restricting their movement transverse to the line. A given insulator may be tested in the laboratory as being satisfactory, said the speaker, but when installed in service and carrying a mechanical load the same insulator will often break down at a pressure much lower than the test voltage. In closing the speaker recommended the use of steel-core aluminum conductors as effecting savings of 10 to 15 per cent over copper.

Mr. P. H. Thomas, New York, declared that the trouble developed by insulators after a period of service is not due to deterioration of the porcelain nor to the presence of electrical potential, but appears to be an inherent result of the process of manufacture. During the twisting operations to which the insulator material is subjected planes of separation probably form, and these, although glazed over and concealed, ultimately result in trouble. In the respect of avoiding such troubles the two-piece insulator has an advantage, since if one shell is defective it is not likely that the other will be.

In a written communication, Dr. William McClellan, New York, discussed the subject of transmission-line towers, and advised that out of a given design or group at least one tower be tested to destruction. He recommended replacing the usual factor of safety with a "margin of safety" based on the difference between the ultimate strength and the working stress. Such a nomenclature, he pointed out, will avoid the tendency on the part of the construction man to consider a tower good for any load not exceeding that for which it has been tested. Mention was also made of the use of special semi-tension strings of insulators for anchoring, two strings being arranged like an inverted V at angles of 45 deg. to prevent one span from robbing an adjoining span of its sag.

Prof. V. Karapetoff, Ithaca, N. Y., objected to the form of expression of Mr. Rushmore's recommendation that line conductors be drawn up tight, and asked that this be modified so as not to discredit the desirability of calculating sags in conductor spans.

Mr. P. M. Lincoln, Pittsburgh, Pa., reported that he had never observed any bad effects due to switching on the high-tension side. The surges due to switching, he pointed out, are slight, and a system disturbed by such slight surges would not withstand the effects of lightning. Mr. A. O. Austin, Barberton, Ohio, pointed out the difficulty in outlining the cost of a given class of line construction unless local conditions are known. He called attention to the fact that the suspension insulator has a higher flash-over point than the corresponding pin-type insulator and will not spill at pressures at which an equivalent pin-type unit breaks down. Mr. Austin also exhibited a number of lantern slides showing the failures of pin-type and suspension-type insulators. Among the number were several micro-photographs showing the formation of calcium-sulphate crystals in the cement used in the insulators. The formation of these crystals, it is explained, develops considerable bursting action. Circuits were also shown for the manufacturer's final tests, using high-frequency alternating-current and rectified unidirectional potential.

Mr. Farley Osgood, Newark, N. J., declared that the operating engineers of the country are not doing their share in helping manufacturers solve their insulator problems. He asserted that it is impossible for a busy electrical system to avoid frequent switching operations, and he insisted that apparatus must be designed to meet the conditions imposed by ordinary operation.

Mr. J. A. Sandford, Jr., East Liverpool, Ohio, said that the kaolin used in insulator manufacture is practically identical in composition for a large number of the principal deposits from which the porcelain industry is supplied. He decried the existence of fatigue in porcelain and declared that troubles which develop with use have their causes in original flaws in the insulator.

Mr. Julian C. Smith, Montreal, Quebec, said that there is no reason to believe that suspension-type insulators are worse than pin-type insulators in showing trouble of this kind, although the fact that suspension insulators are usually operated with one end grounded involves more severe conditions for this type of unit. He also pointed out the fact that the line must be insulated for the maximum pressure which it is likely to have to withstand from whatever cause, regardless of the nominal operating voltage.

Mr. E. A. Lof, Schenectady, N. Y., urged the placing of transmission conductors high enough to be out of the way of any possible contact from the ground. He also questioned the necessity of grounding steel towers provided with concrete bases.

Mr. E. M. Hewlett, Schenectady, N. Y., said that it has not yet been proved that well-vitrified porcelain undergoes fatigue. Such troubles as develop can usually be traced to faults which are concealed for a time by the glaze covering.

Mr. S. Haar, New York, pointed out the large number of high-tension transmission lines now in operation or shortly to be inaugurated, both in the United States and abroad, including such remote countries as Tasmania, Japan, South Africa, India and South America.

Thursday afternoon's session, which was in charge of Mr. H. W. Buck, New York, was devoted to the presentation and discussion of papers on the economics of power generation. The first paper was an elaborate treatise on the method of properly proportioning the sizes of combining steam-hydraulic plants.

The Economical Capacity of a Combined Hydroelectric and Steam-Power Plant

Mr. Cary T. Hutchinson's paper described a general method for determining the economical capacity of a combined steam and hydroelectric development. The scheme suggested involved the use of a "per-cent-deficiency" diagram, summarizing the stream-flow data,

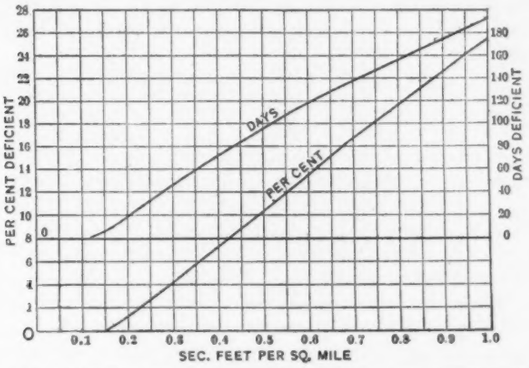


FIG. 2—AVERAGE PER-CENT-DEFICIENCY AND CORRESPONDING AVERAGE DURATION CURVES

and a "per-cent-load" curve, showing the characteristics of the load. The first diagram represents the percentage that the stream flow must be increased to bring the minimum flow up to any assumed value, and therefore indicates the percentage which must be compensated for by steam power. The second curve, based on the energy demand, shows directly the percentage of the total energy which is delivered above any percentage of the maximum power output of the combined plants. The rating of the reserve steam station is therefore determined by the latter curve. The diagrams are used differently, depending on whether the hydroelectric plant has pondage or not. When the energy demand drops for a considerable period below the minimum amount of energy which can be supplied by the hydroelectric plant, it is advisable to supply the base load from the stream and the peak load from the steam plant. In solving numerical examples to show how to estimate the size of the reserve plant, it was pointed out that the cost of the auxiliary energy supply affects the degree to which the main hydraulic plant should be developed. The cost of any hydroelectric development is made up of an amount independent of the rating plus other items which are proportional to the rating. Estimated from a number of developments, the average ratio of the fixed to the total cost is 68 per cent. For hydroelectric plants the fixed annual charge is generally about 14 per cent, while for steam stations it is 20 per cent.

The Cost of Electricity at the Source

By employing the Stott-Gorsuch method, Mr. H. M. Hobart showed that three-phase energy can be delivered to outgoing cables at from 0.91 cent to 0.41 cent per kw-hr. from a 100,000-kw, sixty-cycle generating station operating at 0.5 load-factor with coal costing from $5 to 50 cents per ton. Curves accompanying the paper indicate at a glance the relation between the load-factor, cost of coal and cost of delivering electricity to outgoing cables. These curves are plotted on the assumption that the total investment in the plant per kilowatt is only $35. For water-power plants where there is no charge for water fuel may be considered as negligible in cost. A method was indicated for tracing the increase of cost of electricity at later stages of its journey from the original source to the ultimate consumer.

Discussion

In the heated discussion which followed the delivery of Mr. Hobart's paper, the opinion was generally expressed that too low values had been assumed in determining the cost of generating electrical energy. It was also stated that this paper might be detrimental to the electrical industry as A. I. E. E. proceedings are often quoted as evidence in court proceedings concerning equitable rates to be charged for electric service. Moreover, there will be a tendency for municipal bodies to conclude from this A. I. E. E. paper that all plants can be built for $35 per kw installed, and the low cost of generating energy will be looked upon as the price at which energy can be delivered to customers' premises.

Mr. H. W. Buck, New York, declared that the decreasing cost of energy produced by steam generating stations will make them serious competitors of hydroelectric plants.

Mr. J. W. Lieb, Jr., New York, stated that under conditions obtaining in metropolitan cities like New York $35 per kw of generating equipment installed in a station will rarely cover the bare investment in real estate and buildings.

Mr. H. R. Summerhayes, Schenectady, N. Y., pointed out that now, in a time of mine and railway strikes, the cost per kilowatt of equipment installed is increased considerably by the necessity of providing coal storage.

Dr. C. T. Hutchinson, New York, declared that the buildings and real estate alone for the Fifty-ninth Street plant of the Interborough Rapid Transit Company, New York, cost approximately $65 per kw installed, while the equipment increases this value by $80. The Keokuk installation, where the cost of equipment is about $180 per kw, was cited as another case proving that the value assumed by Mr. Hobart is extremely low. If an investment of $35 per kw installed were sufficient, a steam plant could be operated at extremely low load-

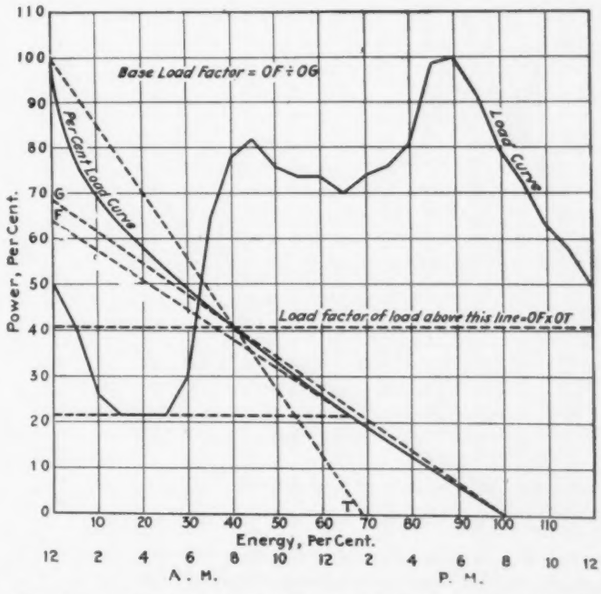

Base Load Factor = OF ÷ OG
Per Cent Load Curve
Load Curve
Load factor of load above this line = OF x OT
Power, Per Cent.
Energy, Per Cent.
A. M.
P. M.

FIG. 3—A PARTICULAR LOAD CURVE AND THE PER-CENT-LOAD CURVE CORRESPONDING TO IT

factors and still compete in rates with this mammoth hydroelectric development.

Mr. H. W. Buck pointed out that the investment required for a steam plant does not necessarily have to be so large as that for a hydroelectric plant since the company operating the former is not compelled to construct expensive high-tension transmission lines or to

maintain a right-of-way to deliver energy to the consumers.

Mr. F. A. Scheffler, New York, said that a company in the West considers that it will be constructing a 120,000-kw station with extreme economy at $45 per kw, but added that it is doubtful if the work can be completed at this figure. The plant will include 20,000-kw turbine units and 2400-hp boilers.

Mr. H. L. Wallau, Cleveland, Ohio, called attention to the unjustifiable demands to adjust rates which, he said, will probably be made by some municipal bodies after reading Mr. Hobart's paper on generating costs. At present an ordinance is pending in Cleveland for a maximum energy rate of 3 cents per kw-hr.

Mr. H. B. Alverson, Buffalo, N. Y., said that load-factors of 50 per cent and higher are rarely obtained, being more often between 30 per cent and 45 per cent.

Dr. Hutchinson advised against the publication of Mr. Hobart's paper as it would be detrimental to the central-station industry, he said.

Mr. O. K. Harlan referred to a paper presented before the American Society of Heating and Ventilating Engineers in which an early installation was traced down to the present time, showing the equipment replacements made necessary by obsolescence, depreciation, etc. The speaker pointed out how these replacements materially increase the cost of energy production. Apparatus which is operating in a perfectly satisfactory way has often been superseded by more efficient apparatus requiring more capital investment. Twenty years was quoted as a useful life for some plants, but this value should be modified because of obsolescence.

Mr. C. F. Scott, New Haven, Conn., declared that the assumptions and results in Mr. Hobart's paper may be ideals to be attained in the future but are certainly not present realities. Floor-space requirements for generating units have been reduced by modern improvements, but the resulting building economies are usually counterbalanced by equipment replacement charges, as there have been several generations of electrical apparatus developed in the last twenty years. He added that Mr. Hobart's generating-cost figures may be mistaken by the lay public to mean total cost, which is not correct as the distribution expenses alone may equal those of generation. As protective equipment is more elaborate than ever, the total cost of delivering energy has been increased rather than decreased.

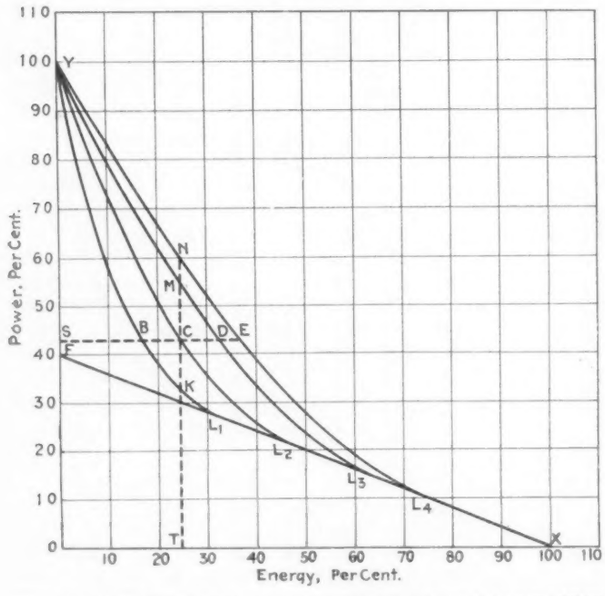


FIG. 4—PER-CENT-LOAD CURVES WITH SAME LOAD-FACTOR SHOWING DIFFERENT AUXILIARY POWER REQUIREMENTS

Mr. H. C. Abell, New York, took exception to Mr. Hobart's assumption of 5 per cent for interest, saying that this was too low. He added that depreciation is more important in estimating expenses than is amortization.

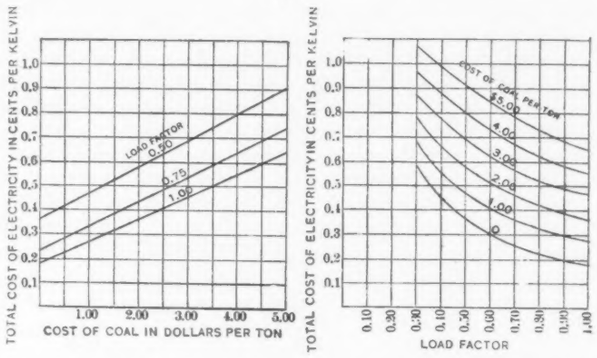


FIG. 5—CURVES SHOWING RELATION OF ENERGY PRODUCTION COST, PRICE OF COAL AND LOAD-FACTOR

Mr. A. H. Kruesi, Schenectady, N. Y., expressed the belief that obsolescence is still more important to consider than either depreciation or amortization. While some boilers have a life of twenty-five years, they generally become obsolete in eight to ten years. Switchboards have become out of date in fifteen years. Fixed charges should not be assumed to be less than 15 per cent, he declared.

Dr. Hutchinson pointed out that since 1886 five complete changes have been necessary in the equipment of the New York Edison Company, making an effective life of about six years for each installation.

Prof. Vladimir Karapetoff, Ithaca, N. Y., said that while the principle employed in Mr. Hobart's paper is correct and the numerical results used are more effective than symbols, the substance of the paper will be misused in court testimony. It would be better to attach the example to some specific case. The speaker also suggested that the Thury system of direct-current generation and transmission receive consideration in the form of an Institute paper giving comparative costs with other systems.

In closing the discussion, Mr. Hobart substantiated his assumptions by values obtained from central-station practice near London, England. He emphasized the fact that his figures were not intended to be representative of conditions in or near large cities, and acknowledged that his assumptions on fixed charges might be low. In one plant in England 6000-kva generating units were purchased from a German concern at $6.50 per rated kw.

Distribution of Electrical Energy

In the report of the sub-committee on distribution, submitted by Mr. P. Junkersfeld, chairman, there were outlined certain recommended distribution practices. Unified operation of generating plants is universally advantageous, as has been amply demonstrated. Substations serving two independent railway systems have also been similarly operated to good advantage in Chicago. By serving railway, lighting and motor circuits from the same substation considerable economies have been effected because of the use of less land and reserve high-tension cable, better load-factor, lower cost per kilowatt installed and decreased operating expenses. The importance of laying out distribution lines properly is shown by the fact that in large cities the fixed charges and operating expenses of a distribution sys-

tem are about three times those of the generating system. An interconnected distributing system is also considered advisable.

Three-Wire Direct-Current Distribution

The permanency of usefulness of the three-wire direct-current system is emphasized in Mr. Philip Torchio's paper. The method of interconnecting feeders, arrangement of subway ducts, types of service connections and equipment of substations as used in a particular case were described. The feeders are interconnected at each street crossing, the total amount of copper in the neutral feeders being about 12 per cent of that in the positive and negative conductors combined. The author said that if the multiple tungsten lamp encroaches into the field of the arc lamp, the advantages of first cost and greater radius of the high-voltage systems will assume greater prominence than they have done heretofore.

Among the latest developments which make possible economical and simplified station operation are the split-pole converter, the synchronous booster and the commutating-pole synchronous converter, with graphite brushes, slotted commutators and self-lubricating copper-graphite brushes for collector rings. Six-phase converters connected diametrically will operate under practically the same conditions as the double-delta type and require simpler connections with the transformers. The installation of storage batteries in substations is a distinctive feature of modern equipment.

Alternating-Current Distribution

For bulk distribution of alternating-current energy, 6600 volts, said Mr. H. B. Gear in his report, is generally used where the radius of energy delivery does not exceed 6 miles; above that distance 20,000 volts is commonly employed. The paper calls attention to the extensive use of 30,000-volt underground cables in Germany. When the direct-current load predominates twenty-five-cycle energy is usually generated, frequency changers being used to supply the alternating-current circuits. If the load on the latter is largest, it is considered best to generate sixty-cycle energy. Bulk-supply systems are preferably built with radial lines and interconnected circuits. As large cables as can be handled should be installed since the kilowatt-carrying capacity increases more rapidly with the size of a cable than does the cost. About $1,000,000 invested in surplus cables in New York and Chicago could have been saved if the circuits could have been operated in parallel and larger converting units had been available prior to 1910. Mr. Gear called attention to a modification of the Merz-Price system of operating circuits in parallel, using "split conductors" which eliminate the use of pilot wires. The equipment of alternating-current substations was described, it being pointed out that induction-type regulators are generally superseding the transformer type. The transformer investment in modern 5000-kw substations is less than one-third of the total cost of the stations.

Single-phase distribution is usually cheapest for small lamp and motor loads, and four-wire, three-phase primary distribution is more economical than the three-wire system when the load exceeds 2000 kw. By supplying lamp and motor loads over the same circuit the power-factor can usually be kept up, and the diversity of demand allows considerable reduction in feeder sizes when the loads have the same magnitude. Since primary feeders cannot be operated in parallel practically because of difficulties in fuse protection, feeders should terminate as close to the center of distribution as possible. Diagrams were published to show methods of laying out single-phase and three-phase systems with this in view. Where possible facilities should be provided for making emergency connections between adjacent feeders, the disconnecting type of pot-head being well adapted to this purpose. Secondary distributing circuits can be connected in a network, for if the load is dropped by one transformer it will be divided among the remaining transformers without danger. Each transformer feeding a network may be equipped with a "network protector" which will automatically disconnect the transformer if it becomes defective. These protectors, which are small transformers having the same ratio as the main transformers, have their windings connected in series with the primary and secondary circuits so that their fuses will blow if the main transformer becomes defective. Secondary circuits may also be fed from centrally located substations or transformers installed in vaults. When the load in a city block exceeds 150 kw it is generally advisable to use direct-current distribution. Checking transformer loads with demand indicators to show the size of transformers required was recommended as a means of minimizing transformer investments. Figures were also presented to give an idea of the average energy demand of individual consumers and groups of consumers.

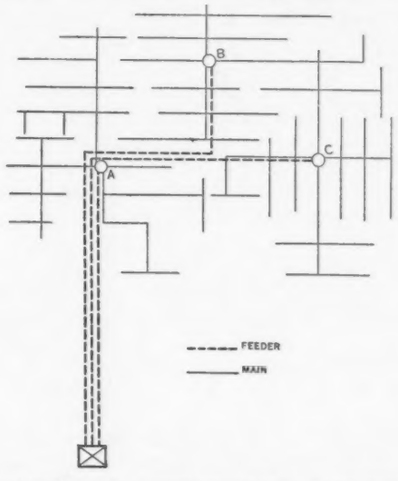


FIG. 6—DIAGRAM OF A THREE-PHASE, FOUR-WIRE DISTRIBUTION SYSTEM

Underground construction should be employed only where required, as on 2200-volt systems it costs from three to five times as much as overhead work.

Effect of Consumer's Apparatus and Wiring on Distribution

Mr. H. Goodwin in his report emphasized the importance of limiting the size of motors which may be connected on single-phase and polyphase lines. The minimum horse-power which electric-service companies allow to be connected on polyphase circuits ranges between 1 and 7.5. Polyphase motors are especially desirable in respect to cost and operating characteristics from both the consumer's and the central station's viewpoints, but the investment in lines, transformers and meters for small motors is greater than for single-phase units. To limit the starting current of elevator induction motors, the resistance change in the rotor-circuit should be made to depend on the current in the feeders. To avoid meter burn-outs it is preferable to connect wireless apparatus to separate transformers. When connected to a primary line designed for a total load of 100 kw or more, electric welders and riveters, used singly, will not cause much disturbance. Best practice on single-phase lines now demands 220-110-volt distribution, a rating of 220 volts for all motors of 1 hp or over, and balancing of load circuits of twenty-

four lamps or over. As the continuity of electric service is now quite generally established, the restrictions placed by the Underwriters on motor-driven fire pumps should be readjusted. The policy of running underground service from underground lines is quite common, but not so from overhead circuits. Consumers can be induced to use apparatus having a high power-factor if the energy rate is made to depend on the maximum energy demand. It would also be desirable to base the minimum energy charge on the motor starting current rather than on the rating.

Direct-Current Distribution for Surface Railways

Street-railway substation and feeder equipment was described in the paper by Mr. R. H. Rice. Because of the increasing reliability of modern electrical apparatus traveling cranes are now being omitted from substation equipment, making it possible to employ lower buildings. Attention was called to the practice of interconnecting converter equipment for emergency operation. The investment in and space occupied by large rotary converters is considerably less per kilowatt than for the small units. Methods of running feeders and supporting trolley wires were described. The radial system of feeding trolley circuits is not so economical as the network system, but is more generally employed because of the ease of sectionalizing in emergency. The author recommends grounding lightning arresters to moist earth rather than to track return circuits. When feeders are supported overhead about five or six lightning arresters should be used per mile. The author recommends using about three insulators between a trolley wire and the span pole. In a system with many feeders and frequent taps the conductivity of the trolley wire is not so important, but its toughness and tensile strength are. A method of computing feeders from the operating schedules was briefly described. Feeders should be designed to carry the current estimated from a two-hour average. A 1,000,000-circ. mil cable is a desirable maximum size to use as it may be easily installed in 3-in. or 3.5-in. ducts. It was suggested that some tests be conducted on the allowable carrying capacity of cables laid in ducts in the earth. When several stations supply energy to a trolley system it is advisable to connect them with equalizing bus-tie circuits. Methods of installing grounded and insulated track returns were described. Negative-return feeders should be connected to each other and to the tracks at frequent points, and the rail joints should preferably be welded to prevent electrolysis of surrounding pipes by stray currents. Short return feeders near the substations may become overloaded unless resistance is inserted to make the drop similar in all returns. Negative boosters may be used with the insulated return system, but they add many operating difficulties.

Direct-Current Distribution for Underground and Elevated Railways

Third-rail systems with track returns as used in this country were discussed in Mr. E. J. Blair's report. Reference was also made to unique equipments in Paris and London operating on the three-wire system. In the latter city where a double-track tube is installed and the traffic practically balanced the third-rails of each track serve as the outer conductors of a three-wire system, while the running rails are used as a grounded neutral. In Paris the third-rail, trolley wire and running rails are used as the three conductors of a three-wire system. In both cases the stray currents are minimized and the running rails are not required to carry much current. Common methods of sectionalizing track circuits were described. One double-track system was recommended in which the track circuits were separated and divided into sections with practically no track switches. A substation feeding a double-track system in two directions should not be required to deliver more than 5000 kw. Where the feed is in four or six directions, as at junction points, a single station may economically supply 10,000 kw. Single sections should be restricted to a length of 2 miles and a load of 4000 amp. By using small substations installed at frequent intervals the track drop can be considerably reduced.

Direct-Current Distribution for Interurban and Steam Railroads

Mr. W. G. Carlton's report gave a brief history of the application of electricity to interurban and steam railroads. It was stated that storage batteries are no longer being used as a part of railway equipment to any great extent, as substation, transmission and generating apparatus is more reliable than formerly. The tendency is to employ 1200 volts or higher on all interurban and electrified steam roads of considerable length. Twenty-eight railroads in this country are now employing or are preparing to use 1200 volts with overhead trolley.

Energy at this voltage is generated directly in a few cases, but as a rule is furnished by converters or motor-generators connected in series. A brief summary of the Butte & Anaconda Railroad equipment closed the paper.

Alternating-Current Distribution for Interurban and Steam Railroads

Mr. W. S. Murray declared in this report that the alternating-current contact wire has no place in the interurban field where the same equipment must be also operated on direct-current city systems. Economies in electrified steam-railroad operation can be secured by delivering twenty-five-cycle high-voltage alternating-current energy through a single overhead conductor. Single-phase, split-phase and even direct-current motors (through the medium of a rectifier) can be used with this system.

The Relation of Distribution Problems and Switching Apparatus

In his paper Mr. E. B. Merriam stated that switching and auxiliary apparatus should be capable of maintaining safe and continuous service, opening overloaded circuits without disturbances, and operating the system at maximum efficiency. On alternating-current systems of 2500 volts or higher switches should be mounted remote from the switchboard on iron or steel bases. It was declared that remote-control 750-volt direct-current switches are becoming standardized. Methods for indicating faults in a distributing system were described. One device consisting of a special series transformer surrounding a three-phase cable operates an indicator when the currents in the cable are unbalanced because of a ground or other fault. Another scheme which required long auxiliary wires depends for its operation on the difference between the current entering the supply end of a feeder and that leaving it. A modification of this device not employing auxiliary wires requires the separation of the feeder in two parts and balancing the currents entering and issuing at the ends of the two sections. Overload, reverse-power and kindred relays were also briefly described. Improvements in alternating-current oil switches are needed, such as facilities for breaking a circuit more rapidly, better confinement of the oil around the arc and an increase in the number of breaks in series. Among methods used for relieving the duties imposed on oil breakers were mentioned the placing of reactances in the circuits to limit short-circuit currents, automatically introducing reactance in the circuit after an abnormal disturbance but before the oil breakers open, and automatically in-

serting resistance in shunt with the switch during operation to assist in dissipating the energy. Attention was called to the use of ironclad switches of all kinds for protection of life.

Distribution for Street-Lighting Service

Street lamps should preferably be fed from a special distributing circuit, Mr. Paul M. Lincoln asserted, so that they may all be controlled from one point. Series distribution permits of central control, but if the lines are required to be installed underground it is usually cheaper to obtain energy from the general electric-service network and to switch the lamps in section. Constant-current direct-current machines for street-lighting circuits are being rapidly replaced by constant-current transformers and rectifiers. Other advantages of a series-lamp circuit were given as follows: Small investment in copper; no loss in ballast resistance as with constant-potential arc lamps; more durable metallic-filament lamps can be used, and reduced radiation from smaller filament areas (especially advantageous with nitrogen-filled lamps). Combination constant-current, constant-potential lamp systems were described. The paper also mentioned a special method employing a reactance shunt to by-pass a broken-filament lamp in a series system.

Discussion

Mr. H. L. Wallau, Cleveland, Ohio, pointed out how lack of centralization in a power generating system involves duplication of investment in land and equipment, as well as of labor. By concentrating the generating units, advantage is taken of the increased diversity, the improved efficiency of larger units, and lower operating costs. The Cleveland Electric Illuminating Company makes use of a special wholesale motor-service schedule in which credit is given the customer for a desirable power-factor.

In answer to an inquiry by Mr. S. D. Sprong, Brooklyn, N. Y., Mr. D. W. Roper, Chicago, Ill., said that short-circuits of the neutral conductor have given no trouble in the Chicago system, nor has any case of the neutral opening caused serious interruption except in a few instances where some outlying customers were affected. According to the present revised practice, the relay settings are now being raised, the idea being to protect the lines not from overloads but from short-circuits.

Mr. E. M. Hewlett, Schenectady, N. Y., pointed out that the operation of the "safety first" clause of the workmen's compensation act may involve serious requirements in the protection against accidental contact of all circuits or apparatus charged at a potential above 220 volts. He advised that proper distinction be drawn between electrical installations in industrial plants and those in power houses and substations under expert attention.

In reply to an inquiry by Mr. H. R. Summerhayes, Schenectady, N. Y., concerning the value of making the neutral conductor of the same size as the "outside" mains, Mr. Philip Torchio, New York, brought out the point that if the neutral is comparatively small and an unbalanced load occurs on the system, the resistance drop in the neutral conductor will tend further to accentuate the voltage unbalancing. The saving in cost between a smaller neutral and a full-sized conductor is so small that Mr. Torchio advised the use of full-sized copper throughout.

Mr. P. S. Taylor, Riverside, Cal., pointed out that in the case of opening an oil switch there is no more inherent reason why energy should be dissipated in the switch itself than in the parallel case of a valve controlling a water-supply system. The series system of arc-lamp operation, said Mr. Taylor, was not developed as a convenience in centralized switching, as explained by one of the authors, but resulted from the regulative characteristic of the arcs themselves and their familiar property of "negative resistance."

Mr. E. W. Trafford, Richmond, Va., described his plan of distributing 4000-volt, three-phase energy in a circuit feeding a total of 200 kva of regulator transformers installed at convenient points about the street-lighting system. In this way separate series circuits are employed having any desired current or voltage. It is also further proposed to improve the power-factor of such lighting circuits by employing static transformers in connection with constant-current units used as regulators, since it is not likely that all the members of a group of arc circuits will open simultaneously.

Mr. A. P. Kelly, Baltimore, Md., told of the trouble formerly experienced with induction motors dropping out when momentary interruptions occurred on the system. To avoid this difficulty, relays have been devised which within 0.7 second automatically close the switch and restore operation on the lines before the moving machinery has come to rest. An equipment of these relays is now receiving a practical test at Baltimore, and it is expected the device will prove particularly useful in substations where no attendants are employed. The relays can be set to close the switches successively once, twice or three times in case of continued trouble, and then failing, they remain out.

Mr. C. Schwartz, New York, presented a written communication in which he made the comment that the cost of generating electrical energy is generally less than the fixed costs of distributing the same energy to customers. He also described the system of distribution employed on the New York Central's 600-volt third-rail electrification entering the New York terminal. A proper comparison of alternating and direct current for any use, said Mr. Schwartz, should involve a study of over-all efficiency measured from the coal pile to the final point of application whether at the drawbar of a locomotive or the shaft of a motor.

Mr. W. A. Delmar, New York, called attention to the distinction which should properly be drawn between distribution and transmission and urged care in preserving correct terminology in the discussion of distribution problems.

The last session of the midwinter convention, held on Friday afternoon with President Mailloux presiding, was devoted to the subject of protective apparatus.

Recording Devices

In this paper Dr. Charles P. Steinmetz called attention to the importance of keeping electrical operating records, pointing out that accurate ones can only be secured by employing automatic devices as the personal element in manual recording is uncertain. The revolving-disk, endless-tape or photo-film, and multi-recording types of instruments were described and their characteristics and limitations commented upon. The first two types produce such condensed records that the sequence of fluctuations cannot be ascertained. With the multi-record device, however, which operates only when an abnormal disturbance takes place, events occurring one-quarter of a second apart can be easily distinguished.

Dr. Steinmetz elaborated upon his paper, emphasizing the importance of knowing what to protect against rather than how to accomplish it, as the latter is of secondary importance.

Discussion

The discussion which ensued related almost entirely to the multi-recorder mentioned in Dr. Steinmetz's paper.

President Mailloux read a written discussion contributed by Mr. Charles L. Clarke, New York, in which parts of Dr. Steinmetz's paper were emphasized, the merits of the multi-recorder commented upon, and the unreliability of personal observations pointed out. Mr. Clarke's discussion also explained how the device can be used to make power-station operation more automatic and how it can be applied to railway, police and fire-department operations and manufacturing processes.

Dr. E. E. F. Creighton, Schenectady, N. Y., briefly described the multi-recorder and referred to a more detailed description in Dr. Steinmetz's paper presented before the A. I. E. E. in 1912.

Dr. Steinmetz pointed out that the device records the exact sequence of events irrespective of the locality in which the disturbance occurs, thereby facilitating the comparison of happenings over an entire system.

The Present Status of Aluminum-Cell Lightning Arresters

According to the paper presented by Dr. E. E. F. Creighton, recent investigations have shown that lightning discharges from the clouds have wave-fronts of various degrees of steepness and are simply impulses and not high-frequency disturbances, as was believed at one time. Reference was also made to recent experiments conducted along this line by Messrs. D. W. Roper and L. A. De Blois. It was pointed out that as long as lightning is believed to have a low frequency and a sloping wave-front, the present types of arresters will endure in principle at least. If, on the other hand, it is proved that strokes have steep wave-fronts and frequencies in excess of 500,000 cycles the existing types of arresters will probably be superseded by "frequency absorbers." Two of the main protective features of an aluminum-cell arrester are its small dielectric-spark lag and its ability to absorb high-frequency potential of less value than normal line voltage.

The discharge rate of a direct-current aluminum-cell arrester at double normal potential is about a million times the leakage current at normal voltage. While the cost and upkeep of this arrester are greater than for older types, the increased expenditure is justified by the better service maintained. Dr. Creighton expressed belief that this type would not be superseded in principle, but thought it might possibly be supplemented in detail, as by the adoption of a cone film which will not deteriorate so quickly when disconnected from the circuit. He justified the use of resistance in series with alternating-current arresters as this arrangement limits the rush of charging current and assists the cell in radiating the energy of a high-potential discharge to ground. Attention was directed to foreign criticisms of aluminum cells which have not been duplicated in this country, and which may be due to inferiority in product, poor voltage regulation, high temperatures or improper supervision of the apparatus. In general, the trouble from these causes may be eliminated by employing charging resistances and the arrester made more nearly immune to damage thereby. Dr. Creighton stated that if a stroke is so intense that it will jump the horn-gap and go directly to ground through the cell without passing through the charging resistance, the menace to the arrester will be insignificant when compared with the damage which might have been done to the line insulation had the short cut not been taken.

Discussion

Mr. W. F. Peek, Jr., Schenectady, N. Y., said that an average of two to three interruptions per day due to electric storms on a mountain line in Colorado have been practically eliminated by the use of aluminum cells, and a larger load has been secured because of increased reliability of service. The line operates at 50,000 volts and the distribution system at 17,000 volts. The arresters were assembled and the electrolyte prepared on the ground about five years ago.

Mr. L. C. Nicholson, Buffalo, N. Y., declared that there is little danger to station apparatus from lightning disturbances on remote parts of the transmission line unless the conductors are highly insulated to ground as the charge is then usually compelled to follow the conductor. By employing gaps which will break down at 100 per cent over-voltage sufficient protection can usually be secured. Aluminum-cell arresters are very reliable, Mr. Nicholson believes, but the principal menace from lightning is directed at the line and insulators instead of at the station apparatus except in direct strokes. He recommends the use of charging resistances on aluminum cells.

President Mailloux suggested that the steepness of a wave-front arriving at a station may depend on the distance away that the disturbance originated and on the intervening reactance.

Dr. Steinmetz pointed out that in order to know where aluminum cells are adaptable operating companies should report when these devices protect against disturbances and when not. The greatest trouble from lightning or surges is caused by the local massing of voltage across a few turns of a reactor. He declared that multi-gap arresters are sensitive to high frequencies, but not to steep wave-fronts. A condenser itself is no protection against lightning, but it acts as a relative short-circuit to high-frequency energy, and a resistance in series with it will dissipate the energy of the disturbance. At a frequency of 100,000 cycles the power-factor of an aluminum cell is practically unity, and it therefore acts as a dead resistance to ground. While gradually relieving a line of an excessive voltage would cause less line surge, it is better to allow immediate relief to prevent the disturbance traveling to damageable equipment. Dr. Steinmetz corroborated President Mailloux's suggestion by saying that the steepness of a wave-front arriving at any point depends on the distance from that point to the place at which the disturbance originates. This can be shown by formulas if the inductance and effective resistance are expressed as functions of the frequency as they should be. He referred to a 90,000-volt line on which a steep wave-front was entirely flattened while traversing 20 miles of transmission line.

Dr. Creighton referred to Mr. Nicholson's remarks and stated that 100,000-volt insulators will usually confine a lightning disturbance to traveling along the conductor, thereby damaging at its terminus the station apparatus. As insulators should be sufficiently large to prevent lightning flash-overs, there is more need of aluminum cells to protect against over-voltages. He stated that considerable trouble has been eliminated by employing aluminum cells. Dr. Creighton closed by saying that he believed porcelain has different insulation values with different wave-fronts and frequencies.

The session was adjourned after President Mailloux had called attention to the success of the last two mid-winter conventions and expressed hope that each succeeding meeting might be equally beneficial.

Ceylon's New Cable Service to London

With the opening of the present year the Eastern Telegraph Company's new cable circuit from Penang to Colombo was completed and communication established between London and the Far East. The Ceylon government is transmitting all of its foreign telegrams over the new cable instead of via India as hitherto.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Sixty-Ton Electrically Equipped Ice Plant at Keokuk

One of the concerns taking advantage of the hydro-electric energy generated by the Mississippi River Power Company at Keokuk, Ia., and distributed locally by the Keokuk Electric Company, is the Purity Ice

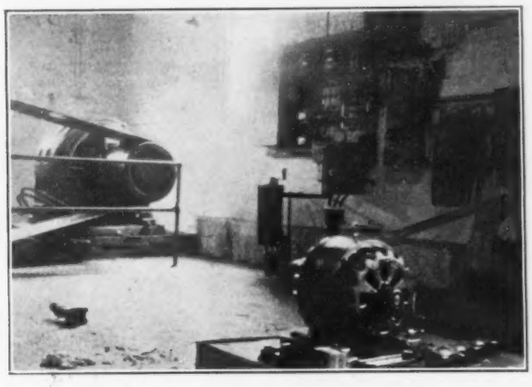


FIG. 1—SWITCHING AND METERING EQUIPMENT AND MOTORS

Company, of Keokuk. Energy for its 60-ton ice plant is brought to the premises at 2200 volts and stepped down to 440 volts by means of three outdoor transformers each rated at 75 kw. The three-phase service entering the 300-amp oil switch may be seen in Fig. 1 just above the small motor in the foreground. Control and metering apparatus for all machines in the compressor room

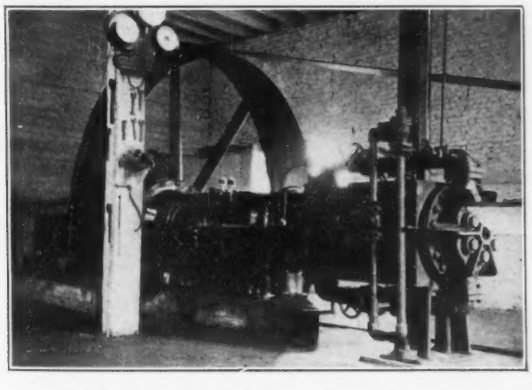


FIG. 2—60-TON BELT-DRIVEN AMMONIA COMPRESSOR

has been been grouped on the wall above the service entrance.

The ammonia compressor (Fig. 2), a Ball's Giant 60-ton machine, is belt-driven by the 200-kw, three-phase, twenty-five-cycle motor shown at the left in Fig. 1. It is started from the drum-type controller shown near the motor. Other motor applications about the plant are given in the accompanying table.

Air supplied from a motor-driven pump is used in an air hoist for lifting the cakes from the freezing tank.

For lighting the tank room, the compressor room and the offices a 5-kw pole-type transformer has been hung

MOTORS USED IN KEOKUK ICE PLANT

Motors	Applications
10-hp	Belted to Connersville blower delivering 2.06 cu. ft. of air per revolution.
5-hp	Belted to two-cylinder, 6-in. by 6-in. air compressor.
10-hp	Direct-connected to centrifugal pump.
5-hp (two motors, 2.5 hp each)	Belted to brine agitators.

on the wall near the switching equipment, reducing the potential from 440 volts to 110 volts. Direct illumination is supplied from tungsten lamps in enameled-steel reflectors.

Exchange Value of Burned-Out Carbon Lamps

In selling tungsten lamps to its customers the Union Electric Light & Power Company, of St. Louis, allows full value, in renewals, for burned-out carbon lamps. A returned carbon lamp, if originally furnished by the company, is valued at 15 cents. Thus if one 60-watt tungsten lamp, priced at 45 cents, is purchased, the customer can pay for it by turning in three burned-out carbon lamps. If the applicant has but two carbon lamps to turn in, he must add 15 cents to get a 60-watt tungsten lamp, and so on.

A Company Tea Room for Women Employees

When the offices of the Merchants' Heat & Light Company, Indianapolis, Ind., were recently moved from the first to the second floor of the building because of the necessity for more room, it was decided that the young women employees of the company should be well taken care of. With that end in view, a 15-ft. by 15-ft. rest room was built at one end of the office, the partition being of board so that there would be absolute privacy.

The company bought a dining table, chairs, knives, forks and spoons and also gave the girls an electric samovar for tea making, an electric stove and toaster and a chafing dish. Each day the young women prepare their lunches in this room, and it has been found that the cost does not exceed $1.50 per week, or about 15 cents per girl. The company pays for all the bread, butter, tea, sugar and cream, which cost about $1.50 per week. Eleven girls are employed and seldom less than ten stay for lunch. The girls figure that they save at least 10 cents each per day, which in the course of a year means a saving to them of at least $300. Not only is the economy appreciated, but in bad weather they find it very convenient not to be compelled to go outside for their lunches.

Eighty Electric Sign Slogans

During the campaign recently conducted by the Edison Electric Illuminating Company of Lebanon, Pa., to install an electric slogan sign for Lebanon, Mr. A. L. Scott, sales agent, issued and distributed an attractive booklet of arguments concerning electric-sign publicity, a feature of which was the accompanying compilation of the electric-sign slogans that have been adopted by a number of American cities. Some of the towns listed have populations of only a few thousand, but are not the less behindhand with their displays for the attention and instruction of visitors and persons on passing railroad trains.

ELECTRIC SLOGANS OF AMERICAN CITIES

Name of City	Population	Electric Sign Slogans
Albany, Ore.	4,275	"The Hub of the Willamette Valley."
Allentown, Pa.	51,913	"Dwell Here and Prosper."
Attalia, Wash.	.....	"On the Columbia."
Birmingham, Ala.	132,685	"Trade in Birmingham."
Boston, Mass.	607,585	"Bigger, Busier, Better Boston."
Bristol, Tenn.	13,395	"Push—That's Bristol."
Bristol, Va.	6,247	"Push—That's Bristol."
Brooklyn, N. Y.	.....	"Brighter Brooklyn."
Buffalo, N. Y.	423,715	"Buffalo Means Business, Boost Buffalo."
Canton, Ohio	50,217	"Welcome."
Chattanooga, Tenn.	44,604	"The City That Pays Dividends."
Chicago, Ill.	2,185,283	"'I Will'—Chicago the Great Central Market."
Cleveland, Ohio	560,663	"Onward, Cleveland!"
Colorado Springs, Col.	29,078	"She Sits Forever in the Sun."
Coos Bay, Ore.	.....	"Oregon's Deep-Sea Harbor."
Dayton, Ohio	116,577	"Greater, Brighter Dayton."
Denver, Col.	213,381	"The City of Lights."
Duluth, Minn.	78,466	"The Zenith City of the Unsalted Seas.'
Durham, N. C.	18,241	"Durham Renowned the World Around.'
East Liverpool, Ohio	20,387	"East Liverpool."
Easton, Pa.	28,523	"Easton, City of Resources."
El Paso, Tex.	39,279	"El Paso, the Pass, Don't Pass El Paso."
El Reno, Okla.	7,872	"Watch It Grow to 100,000."
Enid, Okla.	13,799	"All Roads Lead to Enid."
Everett, Wash.	28,814	"The City of Smokestacks and Opportunity."
Fargo, N. D.	14,331	"The Biggest Little City in the World
Faribault, Minn.	9,001	"Athens of the Northwest."
Fort Smith, Ark.	23,975	"The Southwestern Factory City."
Fort Wayne, Ind.	63,933	"Fort Wayne with Might and Main."
Fort Worth, Tex.	73,312	"Seventeen Railroads—Manufacturing Center."
Galveston, Tex.	36,981	"The Treasure Island of America."
Garden City, Kan.	3,171	"Welcome, Garden City."
Grand Forks, N. D.	12,478	"The Home City of the Northwest."
Great Falls, Mont.	13,948	"Watch Our Smoke."
Hattiesburg, Miss.	11,738	"Hattiesburg—The Hub."
Hood River Valley, Ore	2,331	"The University of Apple Culture."
Houston, Tex.	78,800	"Keep Boostin' Houston."
Hume, Tex.	.....	"Boom Hume."
Indianapolis, Ind.	233,650	"No Mean City."
Jackson, Miss.	21,262	"Share Jackson's Opportunities."
Kalamazoo, Mich.	39,437	"In Kalamazoo We Do."
Lansing, Mich.	31,229	"Larger, Livelier, Lovelier Lansing."
Little Rock, Ark.	45,941	"Little Rock's Population 1920, 200,000."
Mankato, Minn.	10,365	"Mankato for Mine."
Marinette, Wis.	14,610	"A Home for You."
Massillon, Ohio	13,879	"Massillon Invites Industries."
Menominee, Mich.	10,507	"Welcome."
Mobile, Ala.	51,521	"Queen City of the Gulf."
Montgomery, Ala.	38,136	"Your Opportunity."
Mott, Mo.	.....	"Mott is the Spot."
Muscatine, Ia.	16,178	"Come Blow Your Whistle with Us."
Muskogee, Okla.	25,278	"Welcome to Muskogee."
Nashville, Tenn.	110,364	"Nashville Offers Opportunity."
New Haven, Conn.	133,605	"Old Elms, but New Ideas."
New Orleans, La.	339,075	"New Orleans—Gateway to Panama Canal."
New Philadelphia, Ohio	8,542	"Welcome to Our City."
Norristown, Pa.	27,875	"Watch Us Grow."
Oklahoma City, Okla.	68,000	"The Center of Commerce in the Land of Promise."
Parkersburg, W. Va.	17,842	"Parkersburg—Biggest Little City on Earth."
Pasco, Wash.	2,083	"Keep Your Eye on Pasco."
Pittsburgh, Pa.	533,905	"Pittsburgh Promotes Progress."
Redmond, Ore.	.....	"A Garden Spot of the Inland Empire."
Rochester, N. Y.	218,149	"Here Quality Dominates."
Salem, Ore.	14,094	"The Cherry City of the World."
San Diego, Cal.	39,578	"First Port of Call."
Sapulpa, Okla.	8,283	"Salpulpa—The Oil City of the Southwest."
Schenectady, N. Y.	72,826	"Schenectady Lights and Hauls the World."
Scranton, Pa.	129,867	"Watch Scranton Grow."
Shreveport, La.	28,015	"Shreveport Spells Success."
Silverton, Ore.	1,588	"The Heart of the Willamette Valley."
Spokane, Wash.	104,402	"All Roads Lead to Spokane."
St. Joseph, Mo.	77,403	"The City Worth While."
St. Louis, Mo.	687,029	"St. Louis Has the Goods."
Syracuse, N. Y.	137,249	"Syracuse Spells Success"—"If You're in Syracuse You're in Right."
Tacoma, Wash.	83,743	"You'll Like Tacoma"—"Watch Tacoma Grow."
Toledo, Ohio	168,497	"You Will Do Better in Toledo."
Topeka, Kan.	50,000	"Topeka, Kan., Topeka Will."
Tuscaloosa, Ala.	8,407	"Try Tuscaloosa, Ala."
Walla Walla, Wash.	19,364	"What Walla Walla Wants Is You."
Warren, Ohio	11,081	"Opportunity! It's Here!"—"Warren, City of Modern Methods."
Waterloo, Ia.	26,693	"Waterloo's Ways Win."
Wheeling, West Va.	41,641	"Wheeling Means Business."
Wichita, Kan.	52,450	"Watch Wichita Win."

Denver's Electrically Driven 75,000-Loaf Bakery

BY FRANK D. BURR

In Denver, Col., the demand for bread years ago exceeded the capacity of hand manufacture. The high quality required and the large quantities consumed within an accessible territory have proved that the best results can be obtained by mechanical means. The Campbell-Sell Baking Company, of Denver, long ago recognized these advantages and through the use of electric power has built up the largest baking business in the Rocky Mountain region.

Flour is hauled to the bakery directly from the mills and is delivered to two flour elevators (Fig. 1), each driven by a 2-hp, 220-volt Westinghouse motor. Each

FIG. 1—ONE OF THE FLOUR ELEVATORS

elevator is capable of elevating 600 100-lb sacks of flour per hour from the driveway to the storage rooms on the second and third floors, where the flour is allowed to stand exposed to a strong current of air for the purpose of aging it. Enough is kept stored ahead in this condition for a run of twenty-four hours. Four kinds of flour are here blended together by gravity mixers and sifters. Three bucket elevators, each driven by a 10-hp, 220-volt, three-phase motor, elevate the flour to the roof of the second floor, where it is emptied into a hopper, and from there it is dropped through automatic scales to the mixer. Hot and cold artesian water of proper quantity and proper temperature is mixed with the flour, the water being itself pumped from a depth of 700 ft. by means of a Leyner air compressor driven by a 5-hp, 220-volt, three-phase motor.

Mixing is started each day at 2 a. m. Two mixers are used, one a 5-barrel Day mixer, driven by a 10-hp, 220-volt, three-phase General Electric motor, and the other a 10-barrel "New Era" unit, driven by a 15-hp motor. The latter mixer is largely used since it is a double revolving-arm equipment. The inner revolving arm goes faster, tearing up the dough and thus getting the best effect of the starches and glutens. The above contents are mixed in batches of about 1000 lb. each for twenty to thirty minutes, after which yeast, sugar and starch are added. After these are mixed, the mixer

tilts automatically, emptying the dough into a large trough (Fig. 2), where it is kept at a temperature of 80 deg. Fahr. The dough is then allowed to stand in the fresh air and light at this temperature for about eight hours, where it rises and is "rammed down" (or kneaded) three times. It is next deposited in the hopper on the second floor, from which it drops by gravity to two

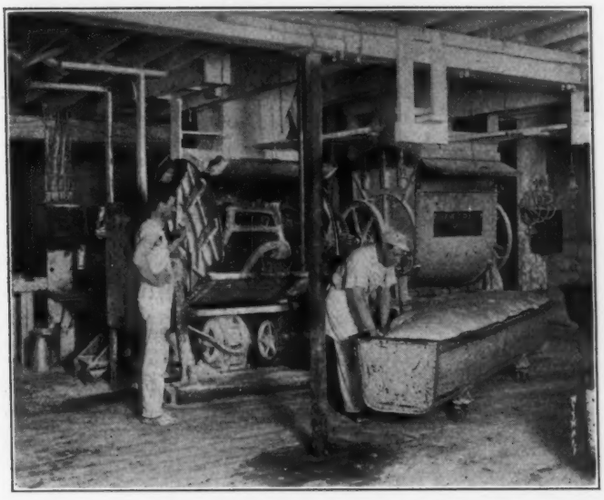


FIG. 2—DOUGH MIXERS AND TROUGH

dividers made by Werner & Pfleinderer and driven by a 2-hp, 220-volt, three-phase motor. The dough in each machine is forced in by a weight, four plungers simultaneously producing four loaves at the rate of 3600 loaves per hour. The loaves are thence dropped upon a conveyor belt, flour is sifted over the belt and loaves, and the latter are conveyed to a Zerah helical baller driven by a 2-hp, three-phase motor.

The interior cylinder rotates, carrying the loaves from the bottom to the top of the helix. The machine produces the effect of kneading the loaves, creating a tough skin so that they will not stick to the belt conveyor. The

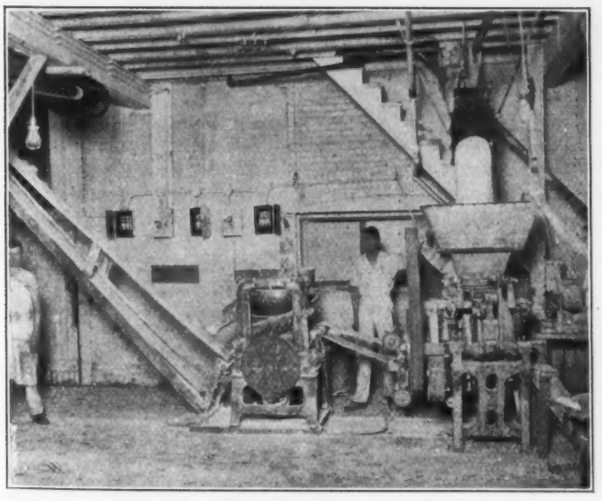


FIG. 3—DOUGH DIVIDER AND HELICAL BALLER

loaves are then deposited upon a belt conveyor driven by a 2-hp, 220-volt, three-phase motor which carries them to the top of the "proofing" conveyor. This device is a patent of the Campbell-Sell Company itself and consists of six endless belts, each 110 ft. long. The speed of the machine depends upon the softness of the dough. The loaves are dropped upon the top belt at one end and conveyed to the opposite end, where they are dropped upon the next endless belt, extending a foot beyond the upper one but running in an opposite direction in the same cabinet. Reaching the end of this belt, the loaf is dropped upon the next belt below, which runs in the same direction as the first, and so on down until it has passed over all six endless belts, the operation requiring seven to sixteen minutes. The belts run in an inclosed cabinet, which retains the moisture and is kept at the proper temperature for the rising or proofing of the loaves. This machine is driven by a 5-hp, 220-volt, three-phase motor. Next the loaves are carried to a loaf-molding machine, made by the C. A. Thompson Company and driven by a 2-hp, 220-volt, three-phase motor.

The milk-and-cream bread is automatically returned to a 9-in. brake molder, thence passing on to a 17-in. molder, after which it is placed in pans. The pans are greased by a Gottschalk machine which has two sets of rotating brushes, one set brushing out the crumbs from the pans which have been used and the second set carrying oily matter to grease the pans. This machine is driven by a ¼-hp motor.

After being properly molded, the loaves are deposited in pans and placed in pan racks supplied with castors, so

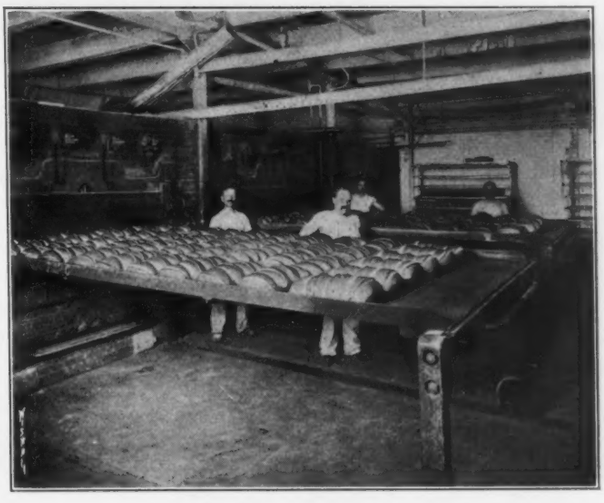


FIG. 4—TWO DRAW-PLATE OVENS

they can be pushed over the floor to the steam-proofing cabinets. Here each pan rack loaded with bread loaves is placed in the proofing cabinet until the loaves have risen sufficiently. The pan racks are then withdrawn and conveyed to the steam peel ovens. They are kept in these ovens until the bread has properly risen, when they go to the draw-plate ovens shown in Fig. 4.

The pans containing the loaves are then placed in racks and taken to the cooling room to form their crusts. The present plant puts out 75,000 loaves per day during the summer. After the crust is formed sufficiently, the loaves are automatically wrapped in waxed paper and sealed by a Haysen wrapping machine, driven by a ¼-hp motor.

Many of the bakery's customers who are supplied with bread have insisted also upon being furnished with pastry. It was therefore found necessary to run a pastry department making various kinds of cakes. This department includes a 2.5-barrel Day mixer with an automatic sifting and elevating arrangement, driven by a 3-hp, 220-volt, three-phase motor; an icing mixer, driven by a 1-hp, 220-volt, three-phase motor; an automatic cake depositor, driven by a 1-hp, 220-volt, three-phase motor, and a three-speed cake mixer, by a 1-hp motor.

Illumination and Wiring

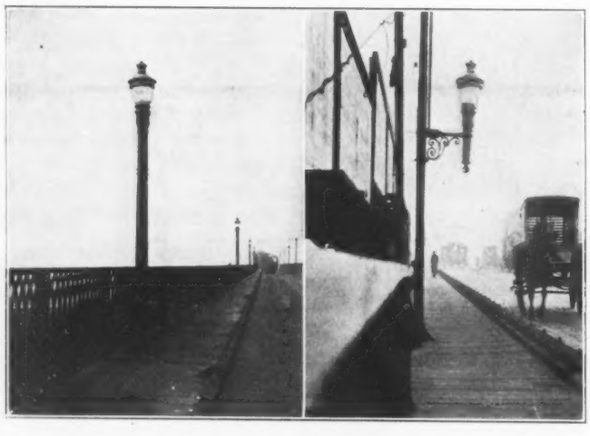
Large Electric Sign in Boston Hospital-Fund Campaign

An electric bulletin about 28 ft. high and 26 ft. wide, mounted on the wall of the Filene-Ditson Building, in the heart of the business district of Boston, Mass., was the most conspicuous feature of a recent successful ten-day money-raising campaign for the new St. Elizabeth's Hospital. The display included a "thermometer" 28 ft. long with a mercury column formed of red ribbon 6 in. wide. As subscriptions increased, the advance of the campaign was recorded on this "instrument." The display was illuminated by six 100-watt tungsten lamps screwed into bases in metal reflectors 18 in. square and 10 in. deep, the reflectors being hung from 10-ft. brackets about 6 ft. away from the wall. The reflectors were painted white on their inside surfaces, and service was maintained from dusk until midnight throughout the campaign. Energy was supplied by the Boston Edison company.

ELECTRIC SIGN IN HOSPITAL CAMPAIGN

Better Lighting for the Eads Bridge, St. Louis

The famous Eads Bridge across the Mississippi River, connecting St. Louis, Mo., and East St. Louis, Ill., is now brilliantly lighted by inverted magnetite lamps, and the improved illumination is creating much favorable comment. Lamps on the Illinois end of the bridge are supported on ornamental iron standards set at the outer edge of the pedestrian walk, as shown in Fig. 1. On the western end of the structure the lamps have been placed on iron brackets attached to the trolley poles of the electric-railway company operating on the bridge, as shown in Fig. 2. Energy for operating the fifty new magnetite lamps is secured from the St. Louis & East St. Louis Electric Railway Company.



FIGS. 1 AND 2—LIGHTING ON EADS BRIDGE, ST. LOUIS, MO.

The Economic Design of a Distributing System

BY M. D. COOPER

The determination of the amount of money which can profitably be invested in a new electrical distribution system or in the reconstruction of an old one is a problem which can often be solved in very definite terms. Its solution is dependent upon the considerations which govern all commercial and engineering problems: "How can the most be got out of a dollar?" or "Will it pay?" These questions can be answered only when it is known how much income can be derived from the investment and how much the charges against the investment and the operating expenses will be.

It is not proposed in this article to treat quantitatively of the fixed charges and expenses of a distribution system, for they depend largely upon local conditions. The point it is desired to emphasize is that oftentimes a much greater investment in lines can be justified on an economic and commercial basis than could be justified by the method of analysis heretofore largely used.

Kelvin's Law of Investment and Losses

This analysis is based on Kelvin's law, which may be stated as follows: "An electric line is built and operated at the least total expense when the fixed expenses on the investment in copper are equal to the cost of the line losses."

The following example illustrates the truth of this law. Suppose that with an investment in copper of $100,000, the cost of energy consumed in the line amounts to $20,000 per year. If the fixed charges—interest, depreciation, taxes, etc.—are 20 per cent of the investment, these fixed charges amount to $20,000 per year, an amount equal to the cost of the line losses. If the copper were increased twofold the line losses would be cut in half, and conditions would be as follows:

Investment in copper	$200,000
Fixed charges on copper (20 per cent)	$40,000
Cost of line losses	10,000
Total annual expenses	$50,000

This amount is seen to be more than in the former case, when the fixed charges were equal to the cost of the line losses. Table I shows what conditions would prevail with various changes in the copper investment. It is seen that the most economical operation of the line is secured when the copper investment is such that the fixed costs and the cost of the line losses are equal.

This analysis is based on the primary assumption that a given amount of energy is to be transmitted from one place to another, and therefore that any decrease of line losses will decrease the coal consumption correspondingly. Such a method of analysis can properly be applied only to problems in transmission. When we come to consider distribution, there enter other factors which modify the application of the analysis.

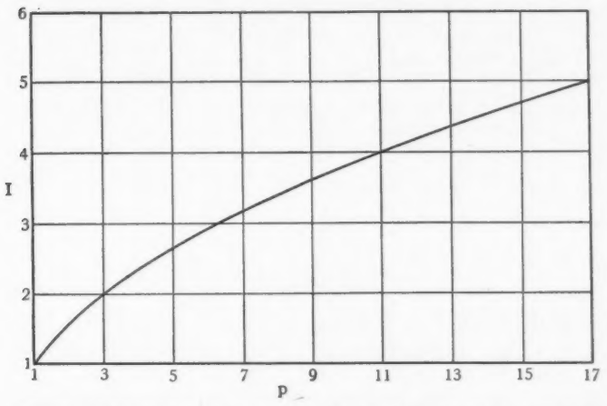
TABLE I—LOSSES AND CHARGES WITH VARIOUS COPPER INVESTMENTS

Investment in Copper	Relative Investment	Annual Fixed Charges, 20 per Cent	Relative Line Losses	Cost of Line Losses	Total Annual Expense
$50,000	0.50	$10,000	2.00	$40,000	$50,000
75,000	0.75	15,000	1.33	26,666	41,666
100,000	1.00	20,000	1.00	20,000	40,000
150,000	1.50	30,000	0.66	13,333	43,333
200,000	2.00	40,000	0.50	10,000	50,000

As applied to the distribution system as a whole, Kelvin's law can still be applied to give approximate results, for an increase in the copper investment would decrease the line losses and allow the maintenance of the same average delivered pressure with a reduction in the station voltage. The intangible but positive value of good regulation as an asset in favor of greater line investment makes it impossible, even in this case, to make strict application of Kelvin's law. As applied to a single feeder (without a regulator) or to a limited district, an increase in copper investment will decrease the line losses by some certain amount, but if the same total amount of energy is delivered to the feeder or district, the energy sales must be increased by the amount of the decrease in losses.

Decrease of Wattage with Terminal Pressure

Direct-current motors, incandescent lamps, flatirons and all energy-consuming devices of the resistor class decrease in wattage consumption as the applied voltage is decreased. For this kind of load, therefore, the effect of line loss between the station or the center of distribution and the load is to cause not only a loss of energy



CURVE SHOWING MOST ECONOMICAL COPPER INVESTMENT

in the line but also a decrease in the energy consumed by the load. Moreover, an increase of voltage means a more than proportionately increased energy consumption by the load itself; hence in this case the increase in copper investment results not only in a saving of line loss or a transfer of part of the loss to the energy sold, but also in the sale of additional energy over and above the transfer of line loss.

The question of how much the total increase in energy sale will amount to depends upon the characteristics of

TABLE II—RELATION BETWEEN WATTAGE AND VOLTAGE

Load	Exponent n
Direct-current motor (constant torque load)	0.8 to 1.0
Direct-current motor (generator load)	About 1.0
Alternating-current motor	About 1.0
Flatiron	1.9
Toaster	2.0
Arc lamp	2.0 to 2.2
Incandescent lamp, carbon	1.9
Incandescent lamp, metallized filament	1.8
Incandescent lamp, tungsten filament	1.6

the load. If the load is a constant resistance, for which the wattage varies as the square of the voltage, the total increase in energy consumption will be twice as great as the decrease in the line losses. If the wattage varies directly with the voltage, the transfer from line loss will constitute the whole of the increased energy consumption.

Table II gives data showing the relation between wattage and voltage for various classes of load. The second column, giving empirical exponents in the assumed relation wattage, varies as (voltage)^n. This table establishes the fact that about 1.5 is a conservative figure for the average exponent in the assumed relation of wattage to voltage.

In general, it can therefore be said that a line reconstruction which decreases the energy loss in the lines by a certain amount in kilowatt-hours will increase the energy sales by about one and one-half times that amount.

The effect of this reconstruction is, therefore, not only

TABLE III—RELATION BETWEEN COPPER INVESTMENT AND COSTS

	RELATIVE COPPER INVESTMENT				
	1.00	1.75	2.00	2.25	2.50
(1) Copper investment	$100,000	$175,000	$200,000	$225,000	$250,000
(2) Fixed charges	20,000	35,000	40,000	45,000	50,000
(3) Cost of line losses*	20,000	11,430	10,000	8,888	8,000
(4) Total expense	40,000	46,430	50,000	53,888	58,000
(5) Transfer from losses to energy sales, $20,000 minus (3)	.....	8,570	10,000	11,111	12,000
(6) Extra energy generated and sold, half of (5)	.....	4,285	5,000	5,555	6,000
(7) Total increase in energy sales (5) plus (6)	.....	12,855	15,000	16,666	18,000
(8) Gross profit on same, two times (7)	.....	25,710	30,000	33,333	36,000
(9) Net expense, (4) minus (8)	40,000	20,720	20,000	20,555	22,000

*The values given neglect the extra line loss due to the increase in line current. This affects the final result less than 1 per cent.

to decrease the losses but to increase the sale of energy. In applying Kelvin's law the decreased loss is taken into account but no consideration is given to the increased energy sale. Since the sale price of energy is often many times the direct or increment cost of generation, it is evident that a most important item has thus been neglected.

Returning to the previous example, Table III is given to determine the most economical copper investment, assuming that the selling price of energy is three times the direct or increment cost of generation.

This table shows that when the sale price of energy is three times the direct or increment cost of generation the most economical copper investment is twice as much as the amount that would be indicated by applying Kelvin's law.

It can be shown that if the ratio of sale price of energy to the direct cost of generation is p, then, considering this fact, the ratio I of the actual economical copper investment to the apparent economical copper investment as derived by Kelvin's law is given by the relation

$$I = \sqrt{\frac{3p-1}{2}}$$

The accompanying curve shows this relation in a graphical form.

The advisability of investing more money in copper in the reconstruction of old lines and the determination of the amount of copper to use in new lines are problems which require study from several standpoints, one or more of which may govern the final solution. As has been brought out in this article, ordinary conditions of operation will almost always commercially justify a much greater investment in copper than could be justified on the basis of Kelvin's law.

Electricity's Part in Holiday Celebrations

Aside from the revenue derived from the temporary load furnished by electrical decorations erected for festive occasions, the advertising value of such displays should not be overlooked by electric-service companies. In nearly every city of any consequence such occasions

STREET DECORATIONS DURING "VEILED PROPHET" WEEK, ST. LOUIS, MO.

often arise and the growing tendency to use electric lighting for temporary decorations should be carefully encouraged.

The accompanying illustration shows the festoons erected on Seventh Street, St. Louis, Mo., for what was locally known as "Veiled Prophet Week." This event, an annual affair, has been celebrated in the city since the foundation of the secret order of the Veiled Prophet in 1876. This year approximately 2000 16-cp red, white and green carbon lamps were used in the decorations, the expense of which was defrayed by the merchants' associations. The floats of the parade, although drawn by horses, were electrically lighted with energy taken through trolley poles reaching the overhead conductors of the street-railway company along the route of the procession.

Track, Scale and Railroad-Yard Lighting

At the meeting of the Pittsburgh Section of the Illuminating Engineering Society held a short time ago Messrs. H. Kirschberg and A. C. Cotton presented a paper on the subject of "Track, Scale and Railroad-Yard Lighting."

In order to prevent congestion and delay in receiving and classification freight yards, it is important, as pointed out by the authors, that proper lighting be provided. Savings in first cost, energy consumption or maintenance should not be allowed to interfere with the proper selection of the illuminating equipment, although it has been truly said that on railroads in general good lighting, so far from being a matter of course, is conspicuous by its absence.

Of the many special problems of illumination on railroad properties, none perhaps is of greater importance than that of proper track-scale lighting. The cars pass over the scale at a speed of about 2.5 miles per hour, and not only must the weighing be done but the car numbers and weights must also be read from the ends or side of the cars in passing. The entire operation takes only eight to twelve seconds. It is therefore important that efficient lighting be provided in the scale house to permit rapid and accurate weighing, while outside in the yard there must be sufficient illumination to enable trainmen to cut loose the cars and to aid the scale attendants in reading the numbers and the figures giving the weights.

All scale lamps should be controlled by a circuit separate from the yard lamps. The outside lamps should not be visible by the weighmaster, although with the low roofs generally used on scale houses the problem of placing units of sufficient strength and low intrinsic brilliancy is not an easy task.

The lighting of a classification yard should provide space for poles on which to mount lamps, but as this layout is usually drawn up by the maintenance-of-way department, it often happens that the space allotted to the lighting is not only insufficient but also poorly located. Many engineers have treated classification yards as open spaces, lighting them accordingly. As a matter of fact, classification-yard lighting may be more involved than any street or park lighting. A classification yard consists of a series of "streets," each 3 ft. to 4 ft. wide, with "buildings" about 14 ft. high on both sides. The ideal system, therefore, would be to provide light on and between every pair of tracks, although this condition cannot always, of course, be realized.

In brief, the requirements of classification-yard lighting enumerated by the authors are: (1) Illumination of the grade leading from the scale to the yard; (2) illumination of the switches at the head of the yard, to facilitate control of car movements; (3) illumination of every track irrespective of position of adjacent cars; (4) illumination of every car in the yard, and (5) absence of glare from any position in the yard.

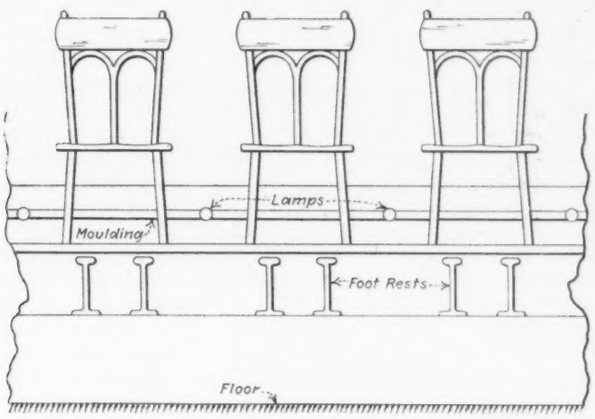
Economic Aspects of Lighting

Mr. H. H. Magdsick, of Cleveland, of the engineering department of the National Quality Lamp Division of the General Electric Company, gave an instructive talk on incandescent lighting at a well-attended luncheon of the Chicago Jovian League on Feb. 23. He explained how the introduction of an inert gas in the bulb will allow the operation of the lamp filament at a higher temperature than in a vacuum. However, the heat of the filament is dissipated much more rapidly than with a vacuum lamp. But with the smaller tungsten filament possible with large units this heat dissipation may be disregarded, so far as lamp efficiency goes. Mr. Magdsick devoted much of his time to a consideration of the problem of waste in electric lighting. Owing to the inefficiency of application, as of lamp shades, fixtures, etc., it is probable that half of the electrical energy used for lighting in the United States is wasted. This waste amounts, no doubt, to $150,000,000 a year. The effort to make more efficient incandescent electric lamps is therefore amply justified on economic grounds. But, considering individual installations, the cost of very good lighting is only a very small proportion of the cost of conducting an industrial plant. It is perhaps equivalent to the wages of one man to every 300 employed.

In many office buildings the cost of lighting is often no more than that of towel supply or pure-water service. Perhaps it is because lighting is, comparatively, so small an item in factory or office expense that it is treated with such indifference. However, it is to be remembered that perhaps 25 per cent of factory accidents are due to poor illumination. In every aspect correct lighting plays an important part in the "safety-first" movement. A small expenditure for improved illumination may mean a great saving in accidents.

Lighting Behind Chairs in Shoe-Shining Shops

Another useful place for electric lamps has been discovered by the new-business department of the People's Light Company, Davenport, Ia. In neat rows behind the chairs of several shoe-shining parlors in the city small lamps have been placed, illuminating the bench



ELECTRIC LAMPS IN SHOE-SHINING PARLORS

on which the chairs for patrons are placed. The light which they shed behind the chairs also plainly reveals spots of dirt and shoe blackening, with the result that in these shops where the dark corners are lighted dirt and spots do not linger and customers may seat themselves without fear of soiling the bottoms of overcoats or dresses.

Recent Telephone Patent

Mr. P. G. Burgess, of Jamaica, N. Y., is the patentee of an intercommunicating system using jacks of the various stations for line terminals, selection of any desired line being effected by inserting a plug of insulating material in the corresponding jack. Ringing is effected by use of ringing keys. The parts and circuits are so arranged that it is impossible for any station to disable the system by careless operating. Ringing and talking currents are supplied from two independent common batteries. It is proposed also to use the set in connection with a dictagraph, and the transmitter is therefore made very sensitive.

Letters to the Editors

The Nitrogen-Filled Lamp

To the Editors of the Electrical World:

SIRS:—In connection with the "new" nitrogen incandescent lamp, about which so much is being said at the present time, it may be of interest to know that the idea of using a nitrogen vacuum in an incandescent lamp is not new. As early as 1880 the writer was engaged with William E. Sawyer (the pioneer incandescent-lamp man) in the development of the then celebrated Sawyer-Man lamps, and at that time all of the Sawyer-Man incandescent lamps were made with nitrogen "vacuums," and the writer now has in his possession two of these lamps containing nitrogen "vacuums." History repeats itself very frequently in this world, and what was then experimental in the beginning of a great industry now is likely to become an important feature in one of the latest developments.

New York, N. Y. E. R. KNOWLES.

To the Editors of the Electrical World:

SIRS:—In a letter from one of the prominent incandescent lamp manufacturers to its local office the employees were urged to apply the name "gettered" to the new nitrogen-filled tungsten lamp which is being brought on the market. In a conversation with a factory representative of the same company, the writer learned that the word is derived from the verb "to get." I presume a "getter" would be "one who gets," and "gettered" would be a participial adjective.

It seems to me that the electrical industry should not have fastened upon it such a meaningless word if there is any possible way to escape it, and that the matter should be referred to the terminology committee of some of our prominent electrical organizations, or the manufacturers themselves, with the request that they adopt some more descriptive name for this new lamp.

BAYARD W. MENDENHALL,
Commercial Agent Utah Light & Power Company.
Salt Lake City.

[The word "getter" is commonly used in the lamp factories when referring to means for producing the desired vacuum, but it has not been adopted generally by the public.—EDS.]

Mr. William Cooper—An Appreciation

To the Editors of the Electrical World:

SIRS:—On Jan. 23, after a short illness, there died in Wilkinsburg, Pa., at his home, Mr. William Cooper. Mr. Cooper was born on a farm near Watertown, N. Y., on Nov. 24, 1861. He had a strong bent for engineering problems which led him to seek scientific training at Cornell University. At twenty-five years of age he went to Ottumwa, Ia., and engaged in the building of automatic screw machines. He left Ottumwa to start a shop in Minneapolis, being at that time very much interested in the utilization of compressed air. The older generation among us well remember how alluring the use of compressed air seemed to the engineers thirty years ago. We all remember the great compressed air power stations at Paris and Mr. Bion J. Arnold's enthusiastic advocacy of the use of compressed air in combination with single-phase alternating currents. Mr. Cooper's labors at the time resulted in the invention of a rotary reciprocating pump and of a power-transmitting and speed-regulating mechanism, which were patented by him and Mr. Hampton on Dec. 19, 1893. A great deal of effort was expended to develop these. After their re-invention by Mr. Harvey D. Williams and improvement by Mr. Reynold Janney, they have been successfully manufactured by the Waterbury Tool Company, of New Britain, Conn., for the moving of turrets on battleships and for other purposes.

After these inventive labors, there followed for Mr. Cooper an active connection as master mechanic and chief engineer of the Twin City Rapid Transit Company of Minneapolis. The interest taken in electric traction work, which had thus been stimulated, induced Mr. Cooper to join Mr. W. B. Potter, of the General Electric Company, in the active development of railway problems. Here Mr. Cooper added greatly to knowledge of commutation of railway motors by calling attention to the advantage of high saturation in the armature cores, this being one of the most important steps toward a proper appreciation of saturation for successful commutation. Mr. Cooper was intrusted with the supervision and operation of the large electric hauling engines built by the General Electric Company for the Baltimore & Ohio tunnel.

After the completion of this work, Mr. Cooper went

to Boston to join the firm of Blood & Hale, consulting engineers. The most notable work he did at that time was the design of a complete line of railway motors for the Steel Motor Company, of Johnstown, Pa., a concern which was later acquired by the Westinghouse interests.

On Sept. 1, 1897, Mr. Cooper became connected with the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, as general superintendent. At this stage the writer became intimately associated with him, and he may be excused for dwelling more particularly on some phase of their personal relationship. Mr. Cooper's unbounded energy and his remarkable personality were a tremendous factor in the development of the Bullock company. His courage, daring and enterprise marked the beginning of the ascendency of that company. Endowed with an unusual gift for the solution of difficult problems, he devoted himself to the development the "teaser" system for the operation of printing presses and to the development of the multiple-voltage system for electrically operating machine tools at adjustable speeds. He was most ably assisted in this work by Mr. Albert Wessling, then chief engineer of the company, and Mr. Charles W. Johnson, then chief draftsman and new general superintendent of the Westinghouse Electric & Manufacturing Company, who had come from the Steel Motor Company, where Mr. Cooper's railway motors had been built. Mr. Cooper's personality carried opposition before him. In my early association with the Bullock company I was chiefly interested in the development of alternating-current machinery and plants, a field to which Mr. Cooper had then given less attention. With one single exception, to which I would not now here refer were it not for the fact that it did more than anything else to bring home to me the great qualities of Mr. Cooper's heart, our relations were cordial and, I believe, implied mutual respect. I was at that time rather young and inexperienced and eager and impatient of results, and I apprehend that I was unjust to Mr. Cooper in occasional criticisms. But to show the more clearly Mr. Cooper's true personality, if I was unjust to him at that time, there came another time when he extended to me the help and assistance and support of his big generous nature; when he evidently buried what friction or disagreement there might have existed, coming out with all his influence and personality to my support. This happened at a time when had he dwelt on retaliation he would have found the widest scope therefor. A personality which can rise so far above personal feeling is one of the rarest types in human nature, and those who have wandered through this wilderness of a world in search for men of honesty and integrity will yield a large meed of admiration to the man whom we have just lost for a breadth of vision and a bigness of heart which are the true marks of nobility of human nature.

Succeeding his connection with the Bullock interests, Mr. Cooper engaged in general consulting engineering, accepting later an offer from the Westinghouse Electric & Manufacturing Company to become connected with its railway department. Here he developed the electro-pneumatic system of multiple-unit control, which has been used by the Westinghouse company successfully in numerous installations. He was vitally interested in the electrical equipment of the New York, New Haven & Hartford Railway and of the St. Clair Tunnel and in the Pennsylvania Railway Company's electrification at New York. But this enumeration does not sum up his influence in the Westinghouse organization. It became my good fortune to meet Mr. Cooper, after several years of separation, at the Westinghouse works. Then I thought that, perhaps, if there lurked in his heart any trace of previous disagreements I should find his influence either arrayed against me or, at least, not with me in the difficult tasks which were confronting the organization and in which I had some part. Instead, I had no truer friend, no more loyal supporter, than William Cooper. He did not confine himself to the times when we came in contact to render me support; he went out of his way to influence members of the organization in my behalf and to impress them with a high opinion of my work. I am loath to mention these matters of intimate personal relationship, but Mr. Cooper has now gone from us and my own active participation in the business to which I refer is also past. And I want all those who have known William Cooper and who may read these lines to know that his was a personality in a million, loyal to his convictions, for better or for worse, a bitter enemy when he believed himself right and a stanch friend when his conviction so dictated. Many men who may read these lines are filling responsible positions which they owe to his exertions in their behalf, and they would gladly acknowledge their share of gratitude to him. He wanted none of it; he seemed not to care for public approval or applause. He severed his connection with the American Institute of Electrical Engineers, of which he was a full member, but he refrained from criticism with dignity and self-control.

WILLIAM COOPER

Mr. Cooper was fond of literature. He delighted in quoting passages from the Bible and from Tennyson. He loved his wife and his home, and he was a good citizen.

The influence and effect of a man's work in the field of engineering is not, and should not be, limited merely by his own engineering achievements. The influence which he casts about him, the principles which he inculcates by his own example and insistence, the atmosphere which he spreads around his field of work, these count for as much as, if not for more than, the engineering achievements which may go with his name. It was well for the corporation which he served almost till his dying day that its president and vice-presidents attended his funeral service, because, though it would have seemed to him, as to us, only slight honor, conjuring up an amused smile to his honest features, it was a healthy sign for the corporation which appreciated the fearless qualities of the man and his opinions, which were never rendered by a desire to pander to the officials of his corporation.

"Hears he now the Voice that lov'd him? Who shall swear it cannot be?
Earth would never touch her worst, were one in fifty such as he!"

Boston, Mass. B. A. Behrend.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Advantages and Disadvantages of Oil Fuel

BY R. T. STROHM

Oil as a fuel has several well-defined advantages over coal and other solid fuels. Perhaps the most apparent of these is the ease and rapidity with which the rate of firing may be changed. In a plant in which regulation is carried out by hand, the simple operation of turning a valve or a cock suffices to increase or decrease the flow of oil to the burners, whereas if automatic regulation is used the ratio of steam to oil and of oil to load are all taken care of by the automatic devices. The result of this action is that the rate of combustion follows the load so closely that the steam pressure can be kept very nearly uniform. In addition to this feature, it is possible to extinguish the fires almost instantly, in case of accident to some part of the plant, and thus prevent further disaster.

Inasmuch as the rate of firing can be increased from almost nothing to the maximum in the short space of time required to open a valve, the response to a sudden increase of load on the boiler is much quicker with oil fuel than with coal. For with coal firing an increase of load is met by throwing greater quantities of fuel on the grates, the immediate result of which is to chill the fire and reduce the amount of heat liberated. After the fresh fuel has become heated and ignited it gives off increased heat, but this requires appreciable time. With oil, the generation of heat is proportional to the amount of oil fed and is simultaneous with the injection of the oil into the furnace. The advantage of this in a plant that is subject to frequent and wide variations in load must be apparent.

In the hands of an ignorant and untrained fireman, however, this ease of control may prove to be a source of trouble and danger. For in getting up steam from a cold boiler or in bringing a banked boiler into normal working condition he may force the firing to such an extent as to burn the plates or tubes and render the boiler unsafe.

An increase of steaming capacity is made possible by a change from solid to liquid fuel, provided, of course, that reasonable precautions are taken to arrange the furnace for the economical use of oil. The increase of capacity is attributable to a number of causes. In the first place, oil has a greater calorific value per pound than coal. A pound of high-grade steam coal will yield 13,500 British thermal units and a pound of oil of average quality will contain 18,600 British thermal units. The difference, 5100 British thermal units, represents 38 per cent of the heating value of the coal; therefore, it may safely be stated that oil has from 30 to 35 per cent greater calorific value than coal.

When burned in the furnace, a greater percentage of the heating value of the oil is utilized than in the case of coal. In the first place, a smaller excess of air is required for oil, because the mixing with the fuel is more thorough. The combustion is therefore more efficient, a greater percentage of the available heat is developed, and the temperature of the furnace is higher than with coal because the weight of gases produced by combustion is smaller. As a consequence, these gases give up more heat to the boiler than do the products of combustion of coal.

The heating surfaces of a properly managed oil-burning boiler are cleaner than those of a coal-burning boiler because the improved furnace conditions lessen the formation of soot, and there are no solid particles to be carried into the tubes by the draft. This renders the transfer of heat from the gases to the water more rapid and raises the evaporative efficiency. Again, with oil fuel there is no necessity for opening the fire doors at frequent intervals, as is done in the hand firing of coal; therefore, the furnace conditions are kept more nearly uniform, there is a better distribution of the heat generated, and the stresses due to the cooling effect of large volumes of cold air admitted to the furnace are avoided.

There are just two fundamental ways of increasing the efficiency of a boiler, and they are to increase the amount of heat generated and to reduce the amount of heat thrown away. With oil as a fuel, less heat is used to raise the temperature of the excess air and more heat is transferred to the water. The net result of these two actions is that a smaller percentage of heat escapes up the chimney in the gases, and so the efficiency is increased.

Because of the slight excess of air that is required in an oil-burning installation the weight of gases formed per pound of oil is less than the weight resulting from the combustion of a pound of coal, and a chimney of smaller capacity can be used. Again, the draft needed for oil fuel is from one-tenth to one-half that necessary for the efficient burning of coal; consequently, the height of the chimney need not be so great when oil is used. In the case of a plant converted from coal burning to oil burning, the existing chimney would be used without alteration, and this particular advantage would be of no immediate benefit; but in the case of a new plant designed for oil fuel the cost of chimney construction would be considerably less than for a coal-burning plant of equal capacity, because of the reduced height and diameter of the chimney.

Another striking advantage of oil as a fuel is the lessening of manual labor by its use. Instead of transporting the fuel from the storage bins in trucks or barrows and feeding it to the furnaces with scoops, as in the case of coal, the oil is drawn from the storage tanks and sent to the burners by steam pumps. As a consequence, the number of firemen may be reduced to one-half or even one-fifth of the original number, depending on the size of the plant and its arrangement. Even a coal-burning plant equipped with conveyors and other mechanical devices requires far more power for handling the fuel than does an oil-burning plant of equal capacity. Moreover, oil can be pumped through pipes to far greater distances and at much smaller expense than would be possible in the case of coal. For example, take the case of a plant situated near a river or other deep waterway, to which fuel could be brought by barges or steamers. If coal were used, expensive machinery would be required to transfer it from the barges to the plant over the intervening distance; but if oil were the fuel, all that would be required would

be a pipe line between the plant and the edge of the river, as compared with the structural work required to carry the coal-handling machinery.

In the matter of storage space required, oil has a vast advantage over coal. Oil possesses about one-third more heating value than an equal weight of coal and a pound of oil occupies about three-fifths of the space required for a pound of coal; therefore, the heating value of the oil that can be stored in a given space is almost 50 per cent greater than that of the coal that could be put in the same space. To put it in another way, the storage space required when oil is used as fuel is only about two-thirds of that for coal, assuming the same boiler horse-power in both cases.

The ashes produced in the burning of coal must be removed periodically. The handling of these ashes in the boiler room produces dust, and the whole process of removal involves expense. Oil produces no ashes and no dust, and, if properly burned, no soot. The result is that there is no expense for removal of ashes, the wear and tear on the pumps in the boiler room is reduced by the absence of dust, and the tubes and surfaces of the boiler remain clean for longer periods than when coal is used. This last condition lessens the frequency of cleaning the tubes and so reduces labor and expense.

The apparatus used in connection with oil burning is simple and is not apt to get out of order; therefore, the cost of maintenance is not great. Burners may wear, owing to the erosion of the oil and steam, or may warp under the effect of the intense heat so as to require renewal; but the absence of moving or sliding parts reduces the repair bills to a minimum. There are no grates to be replaced, and no firing tools are used, so that damage to the bridge wall or to the furnace lining brought about through the careless use of tools is wholly avoided.

It is well known that coal, when stored for any length of time, deteriorates in heating value because of slow oxidation and the escape of hydrocarbons; but oil may be stored for long periods in properly ventilated tanks without losing appreciably in its heating value.

Again, there is the matter of smokelessness to be considered. By reason of the efficient combustion that may be obtained oil can be burned without smoke; so that, in a city in which the production of smoke by manufacturing plants is punished by fines, the use of oil fuel may prove to be the means of solving a trying problem.

One of the chief disadvantages attending the use of oil fuel is imposed by the regulations of insurance companies. To protect the plant from fire that might occur from the ignition of the inflammable oil, it is required that the storage tank shall be 30 ft. from the nearest building and 2 ft. below the surface of the ground, or 200 ft. from inflammable property if located above ground. It may be difficult to comply with these regulations if the ground surrounding a plant is in great demand or is already occupied.

Another disadvantage of oil is the inflammability of the gases given off from it. The danger of explosion of these gases and the subsequent ignition of the oil, however, become of small importance if the oil used has a flash point of 140 deg. Fahr. or more, and if reasonable precautions are taken by engineers and workmen in storing and using it.

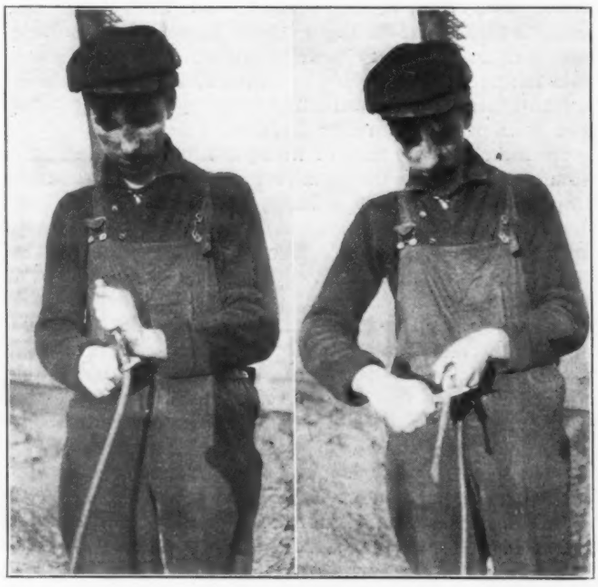
If the boiler feed-water contains a large percentage of scale-forming material, the use of oil fuel may entail increased expense for repairs and tube renewals; for the intense heat generated in an oil-burning furnace is apt to cause more rapid deposit of scale and result in a greater number of burned tubes and plates than with a coal fire.

Preventing Electrical Accidents

In summarizing causes of acidents in the electrical department of the Inland Steel Company, Indiana Harbor, Ind., Mr. Robert L. McIntosh, chief electrical engineer, calls attention to the fact that at least three-quarters of the causes were other than electrical. The following figures for 1912 give the causes of accidents and the percentage that each cause contributed:

Burned by flash or short-circuit	23
Handling material, injured self with same	14
Skinning wire, cut self with knife	10
Fell off ladder, column, etc	8
Struck self with hammer	6
Grinding, emery flew in eye	6
Wrench slipped	4
Tripped, slipped, stumbled or fell	4
Ran nail in hand	4
Miscellaneous—no two alike	21
Total	100

The dangers peculiar to electrical work may be classified under four general heads—shocks, burns, flashes and falls. Many accidents incidental to the work are



FIGS. 1 AND 2—THE DANGEROUS AND THE SAFE WAY TO STRIP WIRE

due to handling material and in connection with the use of tools and machinery. To avoid these accidents men must exercise due care and caution not to drop material on their hands or feet, to cut away instead of toward them when stripping wires, to keep their fingers clear when striking with a hammer, to wear goggles when grinding at emery wheels, to select and use wrenches that fit and are suitable for the work, to watch their steps so as not to slip, trip, stumble and fall, and to be careful when handling boards containing nails.

Shocks may be received from any electric circuit, and the severity of the injury will depend on the amount of current passing through the body. A fatal shock may be received from even a 125-volt circuit. Treat all electrical circuits as though they were alive, is the advice of the steel company's safety department.

Moreover, in handling any circuit known to be alive, men should when possible use only one hand, keeping the other hand behind the back. They should work on one wire at a time and take means to insulate themselves from the ground and other wires of the circuit. Each joint as it is made should be insulated before

starting on another wire. There are numerous ways to receive shocks. Care should be taken not to open the shunt field of a motor in such a way as to allow the inductive discharge to cause shock.

Burns are caused by electric arcs. Arcs may be

FIG. 3—A KNIFE SWITCH MAKES A DANGEROUS CIGARETTE LIGHTER

caused by short-circuits due to getting a tool in contact with both wires of a circuit. To avoid this, handles of tools should be covered with fiber. There is danger of an arc when opening a switch and frequently hands are burned in this way. An arc may also be

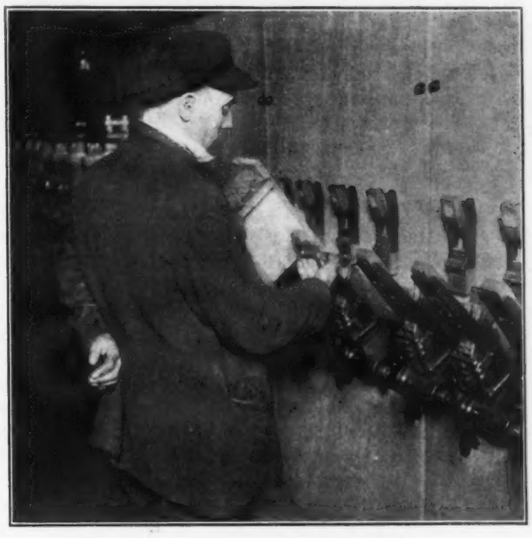


FIG. 4—USE TAPE-HANDLED TOOLS AND KEEP ONE HAND BEHIND BACK

caused by closing a switch on a line which is short-circuited.

Flashes usually acccmpany electric arcs and cause injury to the delicate nerves of the eyes. The pain of exposure does not manifest itself for several hours, and to avoid suffering it is advisable to secure medical attention immediately after exposure.

Falls may be caused by slight shocks. When working overhead the workman should be sure he is protected from falling from scaffold, cranes, etc., in case of shock. When working on poles or doing other overhead work he should wear a belt and safety strap.

Iron Tie-Wires on Copper Transmission Line

What effect, if any, will salt air have on a bare copper transmission line using galvanized-iron tie-wires? A. A. C.

The wire used for tying into insulators should be of the same material and composition as the line conductors themselves, lest local electrolytic action be set up between the dissimilar metals, eating away both and causing the spans to break at the necks of the ties. Especially is this important if the line is installed in a moist or salty atmosphere which would tend to accelerate the electrolytic and destructive action.

Electric Heating of Dwellings

In the Northwest, I am informed, use is made of electricity for heating dwellings and buildings. Can you supply figures on the connected load in heaters required for an average residence, together with some idea of the cost compared with heating by coal? K. N. G.

In Idaho, where a number of dwellings and other structures are heated electrically, it is the practice to allow at least 10 kw for the average house of five or six rooms. Used continuously such a 10-kw heating equipment will consume 240 kw-hr. per day, or 7200 kw-hr. per month. In the Western States where surplus water-power is running to waste several companies have offered special house-heating rates as low as $16 per connected kw for the winter season, making the cost of heating a dwelling of the type above described about $160 per season. Compared with coal at $6 per ton, this cost is not excessive. The energy furnished under the above season schedule is, however, sold at a rate of less than ½ cent per kw-hr.

Size of Feeder Cables for Single-Phase and Polyphase Motors

What formula should be employed in determining the size of feeder cable for delivering energy 500 ft. to a 1600-hp, 2200-volt motor operating at 80 per cent power-factor, both when the motor is a single-phase machine and also when three-phase? The generator develops 2300 volts. G. J. N.

Assuming a motor efficiency of 90 per cent, the power required to operate the motor will be

$$\frac{1600 \times 746}{0.9} = 1{,}327{,}000 \text{ watts (approx.)}$$

The current required on a 2200-volt single-phase circuit at 80 per cent power-factor will be

$$\frac{1600 \times 746}{0.9 \times 0.8 \times 2200} = 755 \text{ amp.}$$

Allowing 4 per cent power loss, or 53.1 kw, the following relation exists

$$I^2R = 53{,}100, \text{ or } R = \frac{53{,}100}{755^2}$$

$= 0.0932$ ohms, total resistance of circuit. No. 00 copper cable has a resistance of 0.0788 ohms per 1000 ft. at 75 deg. Fahr., but will not carry 755 amp within an allowable temperature rise. Lead-sheathed, jute-covered cable having 600,000-circ. mil cross-section may be used, as it will carry 763 amp with a temperature rise of 50 deg. C. The feeder circuit for a three-phase motor operating under the same conditions would consist of three conductors having one-half the cross-section of those used in the single-phase case.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Open and Semi-Closed Slots in Induction Motors.—Th. Hoock.—Although European designers have strictly adhered to the semi-closed slot for three-phase induction motors, American designers early adopted the open slot. The author discusses the advantages and the disadvantages of the open slot and the advantages and the disadvantages of the semi-closed slot, and refers to the effect of the two types of slots on the characteristics and design of a motor. He finally gives a comparative example for a design with open and semi-closed slots in the stator, while the rotor slots are supposed to be semi-closed in both cases. It is shown that motors with open slots can be built having a power-factor equally high with that of motors with semi-closed slots, but the efficiency is somewhat lower, especially for less than full load.—*Elek. u. Masch.* (Vienna), Feb. 15, 1914.

Rotary Converters.—A note on a recent British patent (No. 11,905) of A. H. Railing and C. C. Garrard, of the (British) General Electric Company. The currents which flow in the windings of rotary converters connected to a common alternating-current generator or transformer are equalized by means of a differentially wound choke coil. When the currents are equal the device is neutral, but when the balance is upset a potential difference is produced which tends to restore the current balance.—London *Elec. Eng'ing*, Feb. 12, 1914.

Large Three-Phase Turbo-Generators.—Robert Pohl.—An illustrated article on large American three-phase turbo-generators with reference to recent papers by B. F. Lamme and H. G. Reist.—*Elek. Zeit.*, Feb. 12, 1914.

Testing Induction Motors.—In a continuation of the long illustrated serial on shop-testing of electric apparatus, tests of induction motors are described using the circle-diagram method and the Prony brake method.—*Electric Journal*, February, 1914.

Efficiency of Transformers of Partial Load.—Arthur Palme.—The author describes a method for determining the efficiency of a transformer at any partial load by means of two simple diagrams. The method is credited to the General Electric Company of this country.—*Elek. u. Masch.* (Vienna), Feb. 15, 1914.

Lamps and Lighting

Rating Lamps.—Justus Eck.—A letter in which the writer points out that until recently metallic-filament lamp makers used, largely to their advantage, the horizontal candle-power as their unit while arc-lamp makers adopted the mean hemispherical candle-power, but circumstances have changed, and the present moment seems fitting for the establishment of a correct standard practice. The polar curve of the light-giving unit should be considered when it shows good resultant light distribution. In a certain well-known flame-arc lamp, measured with both inner and outer globe in place, nearly 6000 cp is regularly and constantly obtained at about 20 deg. below the horizontal plane passing through the arc, at a consumption of 600 watts. Are the manufacturers entitled to call this a 0.1-watt lamp, or, in view of its mean hemispherical candle-power, should they call it a 1/6-watt or 1/7-watt lamp? Nitrogen-filled incandescent lamps seem to require a globe to protect either them or the human eye, and this globe unfortunately filters off a considerable percentage of the light. Would it, therefore, be reasonable to call the efficiency of the above flame-arc lamp 1/11-watt, as the measurements stated were made with both the inner and outer globes in place? In the printed particulars of recent forms of tungsten lamps it is said that during a period of 800 to 1000 hours the candle-power will diminish 20 per cent from the initial. Under these circumstances, since the flame-arc lamp in question gives a constant light at all times, it would seem reasonable when comparing it with the tungsten lamps to call it a 1/12-watt or 1/13-watt lamp. An editorial note on the subject agrees with the writer that it would not only be much more satisfactory but also more honest to base measurements of incandescent lamps upon the mean hemispherical candle-power as in the case of arc lamps.—London *Electrician*, Feb. 13, 1914.

Fusing Tungsten.—A note on a recent British patent (No. 10,369, 1913) of Siemens Brothers and the (German) Siemens & Halske A. G. The tungsten to be fused is contained in a crucible in an indifferent atmosphere. The crucible has a lining of compressed tungsten. The tungsten to be fused is made the positive pole of an arc furnace, the negative pole being also of tungsten. To prevent bubbles the tungsten to be fused may have about 1.7 per cent of thorium added to it.—London *Elec. Eng'ing*, Feb. 12, 1914.

Tube Lighting.—A note on two recent British patents (Nos. 1218 1913, and 8712, 1913) of the Moore-Licht A. G. To insure constancy in the light emitted, any impurities in the gas are absorbed or combined chemically by the pulverization or vaporization of auxiliary cathodes by the heat of a Geissler tube discharge. According to the second specification, the color of the light emitted is determined by exciting the tube by superposed currents of particular frequencies.—London *Elec. Eng'ing*, Feb. 12, 1914.

Generation, Transmission and Distribution

Traveling Electric Waves.—Ludwig Binder.—The author gives a hydraulic analogy of the formation of electric waves, their method of traveling, their reflection, and shows how to calculate the speed of propagation. He also discusses the conditions under which a straight wave-front can be obtained and shows that these conditions are not fulfilled in practice. He also gives a hydraulic analogy of the way in which waves enter a machine when a switch is handled, further how waves change when they pass from one line to a different line, and how a short-circuited line behaves.—*Elek. Zeit.*, Feb. 12, 1914.

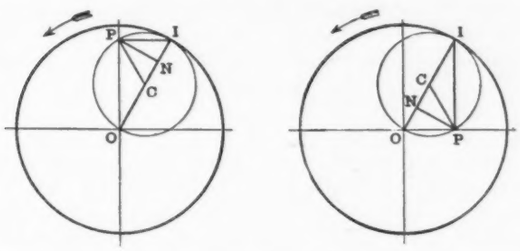
Alternating-Current Calculations.—Karl Richter.—A long mathematical article illustrated by diagrams. For series connections some formulas are developed from which the curves of the currents and partial voltages can be directly obtained for any variable impedance. For the special case of a pure resistance or a pure reactance the results are summed up in tables. The object of the article is to give some general rules and methods which can be applied directly in practice instead of starting the calculations from the very beginning.—*Elek. u. Masch.* (Vienna), Feb. 1 and 8, 1914.

Traction

Railway Electrification.—ROGER T. SMITH.—A long illustrated abstract of a paper read before the (British) Institution of Electrical Engineers. The author discusses the question of electrification for suburban, fast passenger and freight service. The general characteristics of electric and steam traction, together with the conditions which would be favorable for electrification, are dealt with in each of these cases.—London *Electrician*, Feb. 13, 1914.

Electrophysics and Magnetism

Representation of Power in Alternating-Current Diagrams.—F. M. DENTON.—The author thinks that students do not readily obtain a clear conception of the wave of power in an alternating-current circuit. The student sees at once that the power dissipated by an alternating current I in an ohmic resistance R is RI^2 and that, therefore, the shape of the wave of power is obtained by squaring the ordinates of the current-wave, but it strikes him as somewhat mysterious that the power wave should have the shape of a sine wave of double frequency. The ordinary vector diagram contains two vectors, one representing I and the other V, rotating with the angular velocity $2\pi n$. These serve sufficiently well to give a clear conception of the manner of variation of the current and the voltage. If in the same diagram another vector could be shown whose angular velocity would be twice that of the I and V



FIGS. 1 AND 2—ALTERNATING-CURRENT DIAGRAMS

vector, and whose projection plus a constant would be a measure of the instantaneous power, the student would be helped toward a clear conception of the nature of the power wave. The introduction of such a power vector proves to be quite simple. Let the line OI in Fig. 1 represent the current in a resistance R. Then to some scale the same line OI represents also the potential difference over R. Thus the length OP represents to one scale instantaneous current and to another scale instantaneous voltage, and $(OP)^2$ represents instantaneous power. It is obvious that the point P always lies upon the circle having OI as diameter. Now $OP^2 = PN^2 + ON^2$, the line PN having been drawn perpendicular to OI, and $PN^2 = ON \times NI$. Hence $OP^2 = ON \times NI + ON^2 = ON\ (NI + ON)$, or since $(NI + ON)$ is constant, OP^2 is proportional to ON at every instant—that is to say, the power is proportional to ON, $(OC + CN)$. Now, CN is a simple harmonically varying quantity, for it is the projection upon the diameter OI of the circle OPI of the point P moving in uniform velocity around the circumference OPI. The angular velocity of P with reference to OI is obviously twice that of I about O, for the angle PCI is always twice the angle of POC. Thus it is seen that the power at any instant is given by the projection of CP upon OI, plus the constant OC, and that the angular velocity of CP is $4\pi n$. The power vector that was required is the line CP. The case of a circuit of zero power-factor may be dealt with in a similar manner. Referring to Fig. 2, if the projection of OI upon the vertical represent instantaneous current, then to some scale the projection of OI upon the horizontal will represent instantaneous voltage, and the instantaneous power is proportional to the product of $OP \times IP$. That is to say, the power is proportional to the area of the triangle OPI, and therefore to the altitude PN of the same triangle. But PN is the projection of PC upon a diameter of the circle OPI. And, as in the previous case, P moves with uniform angular velocity $4\pi n$ with reference to OI. Hence in this case the power is a simple harmonically varying quantity of double frequency, and it is represented by the crank CP. The case of a circuit of any power-factor may be dealt with by splitting the current into two components, one in phase with the voltage and the other in quadrature.—London *Electrician*, Feb. 6, 1914.

Ionization in the Unstriated Discharge and in the Arc.—C. D. CHILD.—The amount of light given by the unstriated discharge and by the arc indicates that the rate at which ions recombine in these forms of discharge varies as the first power of the current, while the equations usually assumed for discharge through gases would lead us to expect that this rate varies as the square of the current. This is explained by assuming that approximately all of the current is carried by electrons and not by ions of molecular size, and that the great majority of the electrons combine first with molecules and afterward with positive ions. The fact that the electric force in this form of discharge is a linear function of the pressure of the gas is explained by assuming that the ionization is caused by the impact of the more rapidly moving electrons on the molecules and that but few of the collisions between electrons and molecules result either in ionization or in recombination, the greater number resulting in no permanent change in either electrons or molecules. The fact that the electric force decreases slightly when the current is increased is explained by the added assumption that the potential difference through which an electron must go in order to ionize is smaller with larger currents than with small ones.—*Philos. Mag.*, February, 1914.

Luminous Discharges in a Magnetic Field.—R. F. EARHART.—An account of an experimental investigation in which quantitative measurements on the effect of a longitudinal magnetic field on a luminous discharge were made in three gases above and below their critical pressures. Measurements in a uniform magnetic field varying from 0 c.g.s. to 10,000 c.g.s. units were made. The results indicate that at pressures below the critical pressure a weak field increases the current obtained by a given potential difference while strong fields reduce it. The lower the gas pressure the greater must be the critical value of the magnetic field to secure a reduction of the current. Pressures close to the critical pressures show small effects due to magnetization, but above the critical pressure the longitudinal field reduces the current.—*Phys. Review*, February, 1914.

Secondary Gamma Radiation.—D. C. H. FLORANCE.—An investigation of the emergent and returned secondary gamma radiations using radium emanation as a source of primary gamma rays. The experiments confirm the author's earlier results that the secondary gamma radiation becomes gradually less penetrating the greater the angle it makes with the original direction of the primary beam. The penetrating power depends to a certain extent on the thickness of the radiator and on the screening of the emanation. The secondary gamma radiation is completely heterogeneous. The secondary gamma radiation for all radiators is different in type from the primary radiation, and it appears that in the process of scattering some modification has taken place. In the case of elements such

as platinum, mercury and lead there is a small amount of an "extra-radiation" with an absorption coefficient of about 40 cm^{-1} in lead. This "extra-radiation" may be characteristic of the radiator. The production of secondary gamma rays plays an important part in the absorption of the primary gamma rays. Lead produces more secondary gamma rays than does an equal mass of aluminum, zinc or tin. The distribution of the secondary radiation has been examined under various conditions.—*Philos. Mag.*, February, 1914.

Electric Discharge from Liquid Points.—JOHN ZELENY.—An account of an experimental investigation in which the electrical discharge from points whose discharging surfaces consist of slightly acidulated water when placed opposite a metal plate were studied. The positive discharge was found to begin with a momentary current, which was repeated only by an increase in the potential of the point. At higher potentials the discharge current is intermittent, and this is followed by a steady current at still higher potentials. In the last case the liquid meniscus is quiescent and the luminosity covers the surface and is confined to its immediate neighborhood. With the intermittent form of positive discharge the liquid meniscus is agitated and the light starts from a small area on the surface and extends half way to the plate in the arrangement used. The negative discharge is always in the form of a brush discharge and the current is almost always intermittent and the meniscus in motion. The light in this case, however, while starting from a small area of the surface also, extends out into the gas a distance which is only about equal to the diameter of the point. The momentary discharges, which first take place from the liquid surface, produce some effects there which result in an increase in the surface tension. This arises most likely from the surface being cleansed of some material collected there. It is probable that some such effect is likewise produced when metallic surfaces are used. A hydrostatic method is given for measuring the electric intensity at the surface of liquid points both before and during discharge. The surface tension of the liquid may also be obtained with the same apparatus.—*Phys. Review*, February, 1914.

Electrification at Liquid-Gas Surfaces.—H. A. MCTAGGART.—The author has worked out a rotating-cell method of examining the electric charge on small spheres of gas in a liquid. Quincke's observations on the movement to the positive pole of small spheres of air, oxygen and hydrogen in distilled water were repeated, using the rotating cell. The velocity of small spheres of gas in water was found to be proportional to the potential gradient and independent of their size (within limits). The velocity of spheres of air, oxygen and hydrogen in water was found to be about 4.10^{-4} cm./sec./volt/cm. Dissolved salts affect the charge at a gas-liquid surface, the activity of the salt depending on the charge carried by its ions in solution. An air-water surface—in the absence of polyvalent ions—is electrically neutral in a slightly acid solution. A sphere of gas in a solution can change the sign of its charge as it diminishes in size, by being absorbed in the solution. Under the conditions of these experiments the electric charge at a liquid-gas surface appears to be almost independent of the nature of the gas.—*Philos. Mag.*, February, 1914.

Anomalous Zeeman Effect in Satellites of Mercury Lines.—H. NAGAOKA AND T. TAKAMINE.—The separation of the satellites of the mercury lines 4047 and 5461 in magnetic fields is generally anomalous, and the change in wave-length is not linearly proportional to the strength of the field. In high fields some branches of the satellites vanish, and the rate of change of wave-length with corresponding increase of the field becomes equal to that for the branches of the principal line. The intensity of different branches of satellites is generally unequal.—*Philos. Mag.*, February, 1914.

Energy Required to Ionize a Molecule by Collision.—J. S. TOWNSEND.—A brief paper in which the conclusion is reached that "the energy required to produce ionization by collision in air is about $23e/300$, e being the charge on the ion."—*Philos. Mag.*, February, 1914.

Temperature and Magnetism.—N. H. WILLIAMS.—A brief article illustrated by diagrams on some anomalous temperature effects upon magnetized steel.—*Phys. Review*, February, 1914.

Electrochemistry and Batteries

Structure of the Atom.—W. PEDDIE.—The author thinks that the origin of the spectrum series could be found in the complicated structure of the atom itself, rather than in complexity of structure of configurations of electrons circulating in or around a comparatively simple atomic structure. He discusses the structure of the atom under the following headings: the centrally symmetrical atom, the atom characterized by axial rotation, the magnetic field, and the magneton.—*Philos. Mag.*, February, 1914.

Units, Measurements and Instruments

Rational Units.—G. N. LEWIS AND E. Q. ADAMS.—Some theoretical notes on the quantum theory of ultimate rational units with numerical relations between elementary charge, "Wirkungsquantum," and constant of Stefan's law.—*Phys. Review*, February, 1914.

Adjustable Condenser with Law of Squares.—W. DUDDELL.—Continuously adjustable condensers are in considerable use, especially in connection with wireless telegraphy. In using these condensers for the purpose of measurement it often happens that the quantity to be measured is proportional to the square root of the capacity of the condenser, as, for instance, in wave meters of the Donitz type. For this reason it is convenient in many cases to make the capacity of the condenser proportional to the square of the distance traversed by the moving part. Several designs of condensers are described which fulfil this requirement. The most convenient form is shown in Fig. 3, in which the outside edge of the movable plate is shaped to a suitable curve to obtain the square law. The mathematics of arriving at the law of this curve is given.—London *Electrician*, Feb. 6, 1914.

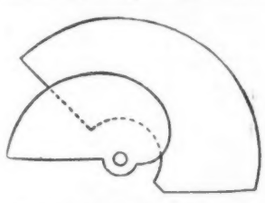


FIG. 3—ADJUSTABLE CONDENSER

Moving-Coil Galvanometer.—PAUL E. KLOPSTEG.—A brief paper in which the author gives the development of two equations for finding the proper size of wire to be used in damping rectangles in order that critical damping may be obtained in moving-coil galvanometers. The first equation is used when the number of turns in the coil cannot be ascertained, the second when this number is known.—*Phys. Review*, February, 1914.

Magnifying Electric Currents.—E. REISZ.—A nearly complete English translation of the author's recent long German article on the magnifying relay of von Lieben and Reisz for telephonic purposes. The original German article was abstracted some time ago in the *Digest*.—London *Electrician*, February, 1914.

Telegraphy, Telephony and Signals

Wireless Telegraphy Transmitters.—A. S. BLATTERMAN.—The first part of a mathematical article in which the author deals in a general way with the electric calculations required in the design of radio-telegraph stations.—London *Electrician*, Feb. 13, 1914.

Miscellaneous

Electrical Accidents.—S. JELLINEK.—The author discusses electrical accidents and deaths by lightning on the basis of a lecture of A. J. Jex-Blake. The fact is emphasized that it is a mistake to think that 100-volt circuits are always safe, since various deaths have occurred in Vienna owing to persons touching electric lamps supplied from 110-volt circuits. While Jex-Blake considered the Schaefer method of resuscitation to be the best, the present author thinks differently. He considers the Sylvester method of artificial respiration to be the only correct and effective one.—*Elek. Zeit.*, Feb. 12, 1914.

British Electrical Trades Unions.—R. W. WEEKES.—An analysis of the present demands of the British electrical trades union in comparison with the rules adopted in 1912 by the British Electrical Contractors' Association. The two sets of rules are placed side by side for comparison. In the present article only wiring work is dealt with.—London *Elec. Rev.*, Feb. 6, 1914.

Book Reviews

JAHRBUCH DER ELEKTROTECHNIK. By Dr. Karl Strecker. Munich: R. Oldenbourgh. Illus., 224 pages. Price, 8 marks.

A carefully prepared compendium of electrotechnical literature and accomplishment for the year 1912. The well-known "Fortschritte der Elektrotechnik," that has been maintained by the Elektrotechnischer Verein from 1887 to 1911, was found to become too burdensome in its original form, and this annual volume is intended to replace it in the future. The work is divided into eighteen chapters and five sections. The latter relate respectively to general matters, electromechanics, electrochemistry, electric signaling, electric measurements and researches. Each chapter has been written by a specialist and the whole collaborated and collected into suitable uniform style by the editor. The work will form a splendid reference book as a member of a very valuable series and has a distinct place in German electrotechnical literature as a supplement to "Science Abstracts" in English.

ELECTRICITY FOR THE FARM AND HOME. By Frank Koester. New York: Sturgis & Walton Company. 280 pages, 53 illus. Price, $1.

It is very generally admitted that a country in which a majority of the people own and operate the soil is likely to be socially and economically stable, whereas a country in which a majority of the people have left agriculture to seek their livelihood as industrial wage-workers is likely to be socially and economically unstable. One of the most serious problems of this age is how to make life on the farms more attractive so as to check the drain to the cities of people lured by inducements and excitements in great variety. In the book before us Mr. Koester has filled a serious gap in electrotechnical literature by explaining in simple language how electricity can most economically be used in the farm and country home so as to save muscular energy and relieve the strain on the physical system of the farmer, enabling him to use machines more and manual power less. A great field and future lie before mechanics, farmers, bankers and engineers in this direction to supply electric power to the land more cheaply than any animal can give it. The fifteen chapters of the book relate to the following topics: Benefits of agricultural electricity; central-station service; generating electric power; electric motor applications; cost of operating; electricity in the manufacture of farm by-products; electricity in the preservation of farm products; electric transportation of farm products; electric plowing; diverse applications of electricity; electric heating; electric lighting; the telephone in rural communities; electric power in irrigation; electric stimulation of vegetation. The book will commend itself to all present and prospective country dwellers, who will come more and more to appreciate the part played by electricity in making farm life attractive.

ELECTRICAL METERS. Prepared in the Extension Division of the University of Wisconsin. (Engineering Education Series.) By Cyril M. Jansky. New York: McGraw-Hill Book Company, Inc. 370 pages, illus. Price, $2.50.

It is hardly possible to treat exhaustively of all kinds of electrical measuring instruments in a single volume; but Professor Jansky has undoubtedly succeeded in giving a simple and comprehensive description of all practical electrical meters and in presenting the essentials of the theory underlying their operation in such a manner as to be readily understood by the average reader. The matter is carefully selected and systematically arranged; the author's style is terse and clear, and the written descriptions and explanations are accompanied by excellent illustrations and diagrams. An introductory chapter deals with the fundamental principles of electricity and magnetism, and although it might be deemed superfluous, the facts are presented so simply and so concisely that the chapter seems neither out of place nor disproportionate in length. Subsequent chapters treat of the fundamental principles of alternating currents and of electro-dynamic instruments. The descriptive and explanatory matter is divided up under main headings covering ammeters and voltmeters, power-measuring instruments, power-factor and frequency meters, graphic recorders, integrating meters and demand indicators. Five chapters are devoted to instrument testing, and in the final chapter reference is made to the various sources of error in electrical measuring instruments. It is probable that the book is not written with the idea that it will be much service to the manufacturer or designer of electrical measuring instruments; but, nevertheless, it is in a book treating of this subject that one expects to find more than a mere reference to such matters as the effects of non-sinusoidal and dissimilar wave-forms on the readings of power-measuring instruments. A discussion of the meaning—or want of meaning—of the expression "phase difference" as applied to two alternating quantities of different wave-forms, together with a more complete exposition of what should be understood by the power-factor of an unbalanced polyphase circuit, might also be embodied with advantage in a second edition. The chief ground, if any exist, for adverse criticism might lie in the fact that the sinusoidal wave-form is generally assumed. This would be an unreasonable objection to make in the case of an elementary textbook on alternating currents; but, as previously mentioned, it is to a book treating exclusively of the theory, construction and operation of measuring instruments that one turns, almost instinctively, for a fairly comprehensive treatment of the effects due to wave-forms differing from the conventional sine curve.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Small Attachment Plug

An attachment plug that has been made as small as possible, although designed for maximum safety to the operator, is shown in the accompanying illustration. The push-in cap is of a convenient size, and the body is so made that it will fit a standard lamp socket. The

ATTACHMENT PLUG

contacts are buried in the base. This plug is being put on the market by Harvey Hubbell, Inc., Bridgeport, Conn.

Electric Curling Iron

The electric curling iron shown herewith is manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The device is designed so that it can be used either with stored heat or

FIG. 1—CURLING IRON COMPLETE

continuous heat. In the former case the swivel plug is pulled out as soon as the iron becomes hot, thus breaking the circuit. With the swivel plug the iron can be freely rotated without twisting the cord when con-

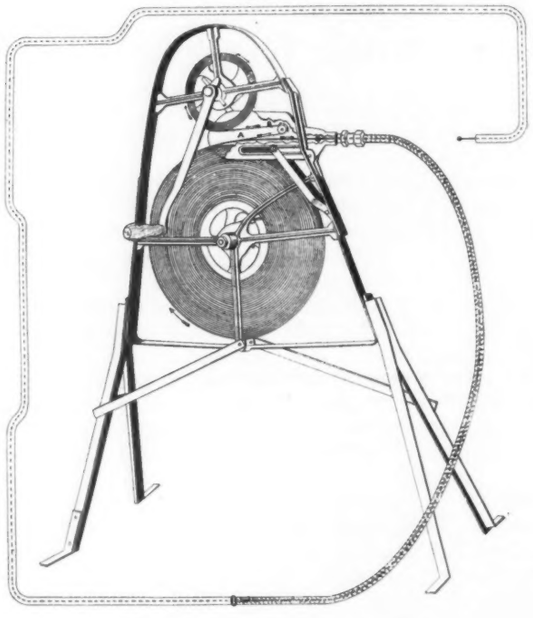
FIG. 2—CURLING IRON, PARTS DETACHED

tinuous heating is desired. The curling iron can be used with or without the hair clamp, which may easily be removed.

The heating element is in the form of a rod inserted directly in the barrel. It can be removed by loosening two screws in the handle. The swivel plug, which fits in the end of the handle, is made of a molded composition, and it will not break if dropped. Strong spring contacts are carried in the plug, and they connect with the terminals of the heater. The cord is attached to the contacts within the swivel plug. None of the live parts are exposed. As the power input is only 15 watts, about 0.1 cent an hour will pay for the use of this curling iron at the average price of energy. All the metal parts are nickel-plated and highly polished. The handle is made of wood, which is black-ebony-finished.

Conduit-Wiring Machine

In the conduit-wiring machine illustrated in the accompanying diagram a fishing tape is conveyed from the periphery of a coil fixed on a wheel by means of a



MACHINE FOR CONDUIT WIRING

superimposed tape which is wound on a second wheel. In the illustration the heavy line *C* represents the fishing tape which is driven through the conduit. The light line *B* represents the lighter tape which by being wound on the upper wheel forces the fishing tape through the flexible-steel hose and thence through the conduit. By placing the crank on the lower wheel and turning it both tapes are re-wound and at the same time the lead wire or insulated conductor is drawn through the conduit. At ordinary speeds the fishing tape travels at 5 ft. per second around any number of bends permitted by city ordinances. The apparatus weighs 27 lb. complete. It is collapsible and can be readily carried by hand. The flexible armored steel base is 12 ft. long. This machine is manufactured by the National Conduit Wiring Machine Company, 25 Broad Street, New York.

Percussion-Type Electric Drill

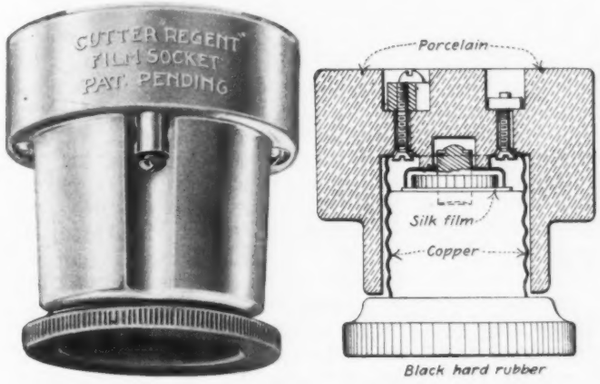
An electric drill of the percussion type for drilling concrete, brick, tiles and marble, made in two sizes, one using a 1/16-hp motor and the other a 1/8-hp motor, has been placed on the market by the Electric Tachometer Company, Philadelphia, Pa. Use is made of a

ELECTRIC DRILL

universal motor for either alternating current or direct current. The weight of the smaller drill is 11 lb. and that of the larger 39 lb.

Improved Film Socket for Street Lamps

A film socket for series street-lighting circuits recently brought out by the George Cutter Company, South Bend, Ind., employs silk as the dielectric medium. As will be seen from the accompanying illustrations, all



FIGS. 1 AND 2—FILM SOCKET FOR STREET LAMPS

metal parts of the socket are inclosed in the porcelain base, preventing possible short-circuits and corrosion. The circular silk film is held securely in place by a copper washer and the film seat is so designed that it is impossible for an unscrupulous repairman to use cigarette papers or wooden splinters in place of the proper silk film. Films of silk, it is said, will puncture at rated voltage and where lamps of high candle-power are to be operated several layers of silk may be used without difficulty. The lamp socket screws into the receptacle and grips the lamp firmly to prevent it falling out. The device has no spring contacts to deteriorate.

Reverse-Power Relay

A reverse-power relay designed for transformer protection in installations where transformer banks are operated in parallel has been developed by the Condit Electrical Manufacturing Company, Boston, Mass.

These relays are designed for service where it is desired to open the alternating-current circuits when the direction of energy flow or power is reversed. A circuit-breaker with shunt trip coils is required, the relay making connection to the trip coil to open the breaker, the specific purpose being to cut out instantly that particular bank of transformers wherein a fault may occur without the interruption of the remainder

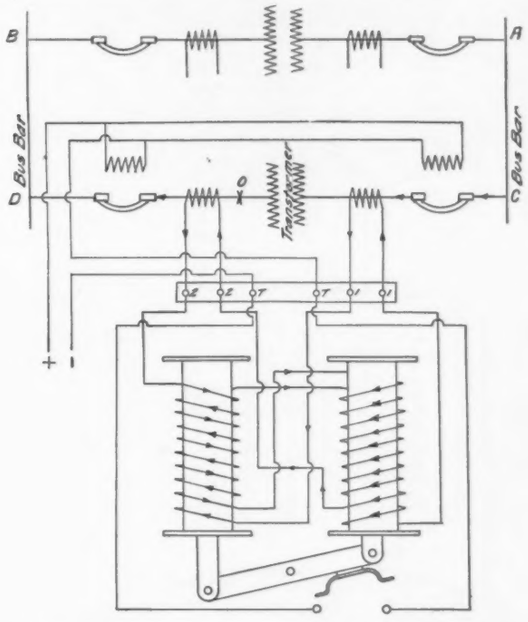


FIG. 1—WIRING DIAGRAM SHOWING RELAY CONNECTIONS

of the system. The relay will operate equally well on all transformer connections; that is to say, on delta-delta, star-star or delta-star, as the case may be.

The relay consists of two powerful electromagnets which either close or maintain the tripping circuit open. Upon a reversal of power the relay is adjusted to operate and permit the tripping circuit to be closed, resulting in a simultaneous opening of the circuit-breakers on both the primary and the secondary sides of the transformer bank.

The wiring diagram in Fig. 1 illustrates the electric circuits of the relay; instead of tripping the breakers mechanically, it closes a contact which allows current to pass through the shunt trip coils of the breakers, thus permitting them to open. Its operation is independent of overloads or short-circuits, series transformer characteristics, potential or direction of energy flow, and operates only when there is a relative reversal of power in the primary and secondary circuits of the transformers.

Assuming the direction of the current to be as indicated by the arrows in Fig. 1, under normal load con-

ditions, the current from *C* to *D* has no effect upon the relay except to keep the contacts of the shunt trip circuit open. Should a fault occur, however, at the point *O*, for instance, the tendency would be for the energy to flow in the direction *A*, *B*, *D*, *O*, causing a reversal of power in a section of the feeder *D*, *O*. This action likewise produces a reversal of power in the series transformer and causes the relay to operate and close the shunt trip coils of the circuit-breakers. Since the circuit-breakers both open simultaneously the faulty bank of transformers is completely isolated, and the continuity of the entire system is not interrupted.

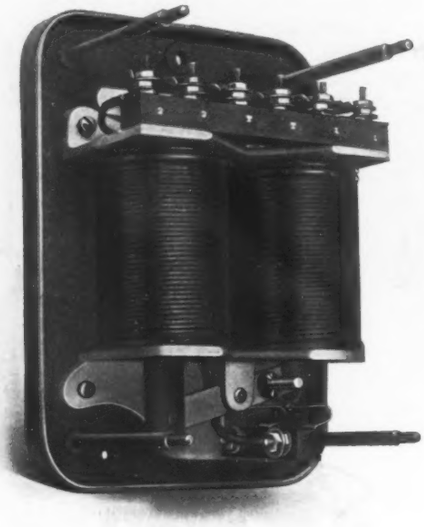


FIG. 2—RELAY WITH COVER REMOVED

Fig. 2 shows the relay with cover removed. It is designed with few moving parts and is well insulated. It is arranged to operate on a reversal of 2 amp of secondary current and requires only 20 volt-amp for its operation. The relay is inclosed in a dustproof case, having a black oxidized finish and is suitable for installation on a switchboard. The device is 6 in. wide, 8 in. long and 4 in. high.

Instrument Posts for Electrically Operated Control Outfits

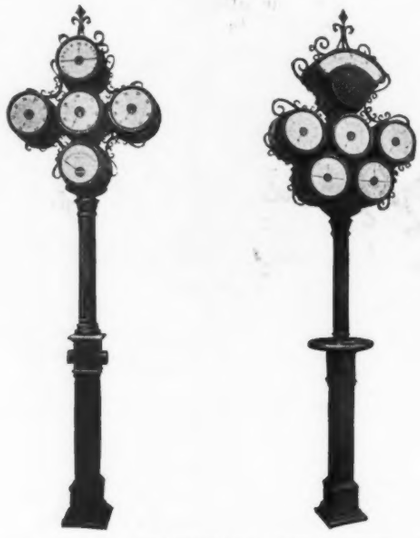
Instrument posts are often used for mounting meters in a generating station in place of an instrument switchboard. The wiring is concealed in the interior of the posts. These posts provide a very convenient and ornamental method of mounting meters, and the instruments are placed in such a position that they can be observed readily without obstructing the general view of the operator.

The usual arrangement is to have the posts support the railing of an operating gallery, each post being placed in front of its respective controlling apparatus, which is usually installed on a suitable controlling pedestal.

The posts may be secured to the floor either by bolting the shank to the side of channel-iron beams under the floor or by using a bolted flange collar, which is secured to the post and is provided with holes for holding down the bolts. With concrete floors use can be made of sockets which may be set into the floors and are designed for bolting to the flange collar.

On standard ornamental posts plates are provided where the hand railing is usually attached, but when required hand-rail bosses may be substituted. These bosses are drilled to take a standard 2-in. pipe, with an outside diameter of 2⅜ in. Posts with panel bases cannot be arranged for hand railing. These posts are finished in dead black. The posts having paneled bases are equipped with panels of slate with black marine finish.

Two styles of pedestals are made, one with an ornamental base and the other with a paneled base for the mounting of control apparatus. Each of these types is also made with a stationary top and with a swivel top, which can be turned about by means of a hand-wheel just above the base.



FIGS. 1 AND 2—STATIONARY AND SWIVEL POSTS

These instrument posts are built by the Westinghouse Electric & Manufacturing Company.

Fuel Gas Power Plant

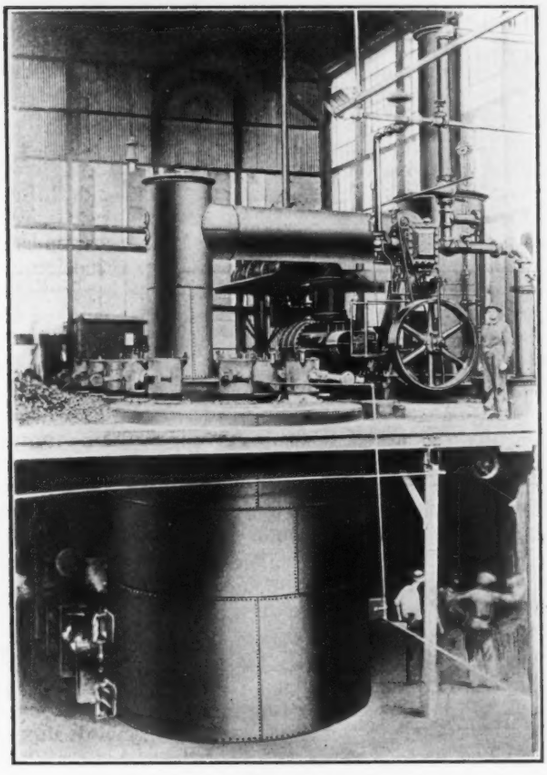
What is declared to be the largest gas producer in the world has been built by the Smith Gas Power Company, Lexington, Ohio. This producer is of the up-draft type and is operated with bituminous coal. The complete producer plant is shown in the accompanying illustration. It has an aggregate grate area of 240 sq. ft. The gas generator, saturator and primary cooler set are installed on the lower floor and the gas exhauster and tar extractor on the charging or second floor. The gas is drawn from the top of the producer through the central vertical flue to the primary cooler. From the cooler it passes to the exhaust and is pumped through the tar extractor into the gas main. The grates are mechanically operated.

The producer is built up of a series of five transverse sections all of which are identical in construction. The shell is made of 0.375-in. open-hearth steel plate securely braced both vertically and longitudinally. Each section carries its own grate and gas outlet, and its air supply and ash-handling equipments are completely segregated from those of the other sections. Doors are placed on each side of each ash pit, and through these the operation of the grates may be observed. The fire-brick lining is 12 in. thick and is arched across the top below the head. The cross-section of the fuel bed is rectangular, although the ends

of the generator are rounded for structural reasons.

The fuel magazine above the lower end of the gas outlet is divided laterally into pockets each of which has its own charging hopper. Each section, therefore, acts in a way as a small producer unit. The fuel bed is supported upon a central flat grate, with sloping grates rising at an angle of 45 deg. on either side and operated in much the same manner as inclined mechanical stokers. These stoking grates may be operated continuously or at intervals as conditions require, and the speed may be varied to suit load conditions. The flat grate is made up of rocker sections and is operated, at the will of the attendant, by means of an air cylinder. This grate cuts all ash from the center of the producer and keeps the fire clean and free.

In conjunction with the producer a tar extractor is used. It consists essentially of a gas pump or extractor which forces at high velocity the raw gas containing



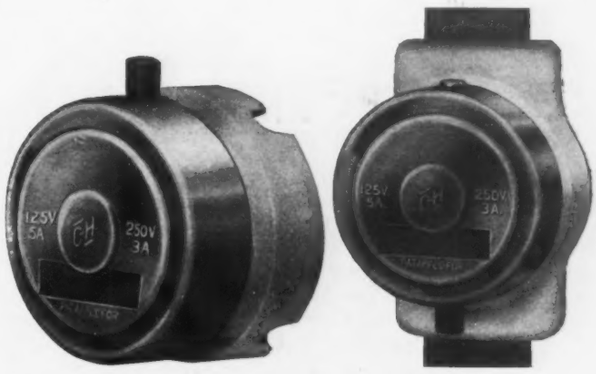
UP-DRAFT PRODUCER

minute particles of tar fog through a glass-wool mat. The tar fog tends to agglomerate into larger drops after passing through the mat and falls into a trap.

Snap Switches

To its rectangular-base and round-base snap switches the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has added six new styles. These devices are used with open wiring, conduit, wooden and metal molding and concealed knobs and tubes. The accompanying illustrations show two of these switches. A "snap-locking" cap is provided, which eliminates the use of screws and saves time in installing. Two small slots which are cut in the side of the cap diametrically opposite each other and near the push-buttons engage with two nibs secured to the base.

In removing the cap the sides are pressed together and then moved upward, thus producing a bulge which causes one slot to be released from its nib. The cap is replaced by first engaging one slot, then pressing the sides so that the other slot slips over its nib and locks it in place. The usual push-button mechanism is used. Each switch has one button which indicates that the circuit is open and another indicating that it is



FIGS. 1 AND 2—PUSH-BUTTON SNAP SWITCHES WITH SLOTTED BASE AND WITH METAL-MOLDING BASE

closed. The caps are furnished either plain or with a label holder for designating the circuit or lamps controlled.

Aluminum Percolator

In order to eliminate the "brassy" taste which, it is declared, utensils made of copper or brass convey to food, manufacturers of electric-cooking devices are devoting much of their attention to other metals. The percolator shown in the accompanying illustration is made of aluminum and German silver. A glass top is provided for observing the brew. The handle is made of ebonwood. The tube and jacket and the shell inclosing the heating element are of German silver, and the

PERCOLATOR MADE OF ALUMINUM AND GERMAN SILVER

spout, pot, lid, base, basket and cover are of aluminum. The heating element can be easily removed. The cover is not hinged but locks with a groove-and-catch arrangement.

This percolator weighs only 1.75 lb. It is known as the El Perco and is being put on the market by the Hotpoint Electric Heating Company, Ontario, Cal.

Jobber, Dealer and Contractor

Municipal Plant Abandons Sale of Supplies

Following the plan adopted by many privately owned central-station companies, the municipal plant at Lafayette, Ga., will turn over the business of handling electrical supplies to a retail concern engaged exclusively in the sale of these supplies and will discontinue the handling of electrical goods which it has heretofore carried in stock. The Lafayette Plumbing & Electric Company is the style of the new firm, which began business Feb. 1.

Rating of Electric Flatirons

A writer in the *Edison Round Table* of Chicago reports that one of the employees of the Commonwealth Edison Company recently purchased what was supposed to be a 110-volt flatiron. The utensil failed to give satisfaction and it was sent to the repair department of the company, where it was found that the iron was built for operation on a 220-volt circuit, although the manufacturer's stamp indicated the voltage on which it was to be used as 110 volts. This may be a quite exceptional case, but it indicates one possible cause of trouble when complaints of electric flatirons are reported.

Chicago Electric Shop Doing a Good Business

According to Manager George B. Johnson, the business prospects of the Electric Shop of Chicago for the year 1914 are flattering. The month of January showed a substantial increase over the business of January, 1913, and in February the gross sales were approximately 50 per cent greater than those of February last year. Most of the patrons of this beautiful electrical shopping place are women, and the articles most numerously sold are toasters, flatirons, chafing dishes and portable lamps. It is reported, however, that a special increase in business is noted in the sale of medium-priced suction cleaners for household use. The advertising department of the Commonwealth Edison Company has provided the Electric Shop with a handsome colored souvenir post card. This represents in colors the interior of the store, and no doubt many of these cards will be mailed to friends by out-of-town visitors.

Electric-Heating "Wrinkles" for Automobiles

The Denver Gas & Electric Light Company is carrying a stock of electric-vehicle heaters made by the American Electrical Heater Company. This heater is intended to be connected to the battery of an electric automobile. It is operated by a switch and may be used by the occupant of the car at his convenience. The heater is rated to consume 100 watts an hour. The enterprising Denver company is about to add to its line of electrical appliances an electric water heater which is used to keep the water in the circulating system of a gasoline engine at a temperature high enough to prevent freezing, thus facilitating the easy starting of the engine in winter weather. This heater is placed in the water line at a point just before that at which the water enters the bottom of the radiator. It is wound for 110 volts and can be connected to any ordinary lamp socket. The installation of this heater interferes in no way with the circulating system of any gasoline engine. Its consumption of energy is 300 watts an hour, and it is adapted for use in connection with gasoline automobiles that are sheltered in unheated garages. Another appliance which is finding favor with automobile owners in Denver is an electric tire vulcanizer. This appliance is automatic and enables the owner of a car immediately to close up any cuts that may be discovered in the casing of a tire. It may also be used for closing punctures in the inner tube by the vulcanizing process. The appliance has a rated consumption of 500 watts an hour and can be attached to any lamp socket.

Co-operation Between the Electrical Contractor and Central Stations

Mr. J. F. Ramier, manager of the Memphis Consolidated Gas & Electric Company, addressed the Tennessee Electrical Contractors' Association at its recent convention in Memphis on Feb. 17 and 18 on the subject of co-operation. He said the subject head which brought out all of the points of mutual interest between the contractor and central station was synchronism, because neither the contractor nor the central station has the time to pull the other along. Both are forced to a gait which is so rapid that only a perfectly running machine or organism can possibly survive long, and while both the central station and the contractor can be synchronized and by running in parallel can occasionally stand the swings of cross-currents between them, they must keep these fluctuations off the line. From an experience of three years, Mr. Ramier said that a large part of the phenomenal growth of electricity in Memphis can be attributed to the ready response with which the contractors have received the central station's plans. There was a time when the growth of motor load was slow and the actual load carried small. An active campaign on the part of the central station resulted in an increased load of from 25 to 30 per cent yearly. This caused the contractors to take an interest, with the result that because of their efforts another and equal addition was made to the central-station motor load. Next the central station began to boost electric fans. One season was sufficient to bring it the assistance of the contractors, and an active campaign on their part showed expected results. By that time the experience of the central station was such as to warrant its refraining from selling appliances altogether and confining itself to that moral and financial support which results in making the contractor a strong part of the central-station organization.

Mr. Ramier claimed that Memphis has more homes using electricity in proportion to its inhabitants than any of its sister cities, and because of its system of rates it is more common than otherwise for a new consumer of electricity to go to the contractor and the architect. The first inkling the central station has of the business is when it is asked to connect up the service. According to Mr. Ramier, the central station in Memphis is facing problems such as energy theft and fire protection as well as the problem of keeping in closer touch with each installation, and while it is spending money asking the assistance of contractors along these lines, it is aware of the fact that sooner or later the question of still further reducing the cost of illumination by increasing the lamp efficiency will call for new methods. The company is studying hard, with a confidence born of experience that when the proposition is put fairly to the contractors it will speedily be settled in a manner that will testify to the advantages of co-operation between the central station and the contractor.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Booming the Electric Sign Business.—The Denver (Col.) Gas & Electric Company has adopted a novel plan for pushing its electric sign business. A card was issued recently giving the number of people who pass one of the busy street corners of that city on an average winter night between 6 and 12 p. m. Along with this feature of interest, an offer is made to furnish advice as to the location of signs, design sketches for the same, and to furnish also a count of the number of people passing any given point, to whom an electric sign might carry a selling talk.

New Slogan for Fuse Manufacturer.—The Economy Fuse & Manufacturing Company, of Chicago, has adopted a slogan which seems to combine business with altruism and which will be used on its business correspondence. By means of an embossing stamp two concentric rings are impressed in the paper, in the center of the inner ring the words "Safety first" being stamped and between the inner and outer rings the words "Economy next." The special points worth noting in connection with the novelty are the particular merit of the slogan itself and the cheapness of the method of application.

Glass Factory Makes Unusual Load Arrangement.—The Illinois Glass Company, operating in Alton, Ill., has recently discontinued the use of its 400-kw steam plant in favor of electric drive with energy supplied by the East St. Louis Light & Power Company. The glass company will take 400 kw continuously from the electric-service company's mains at 2300 volts pressure, and for the peaks on its own system, amounting to from 200 kw to 400 kw, will operate its own producer-gas engines. It is expected in this way to secure a low motor-service rate and at the same time utilize most of the producer gas generated.

Plans of the American Electric Car Company.—Note was made in the Jan. 31 issue of the *Electrical World* on the merging of the Argo, Broc and Borland-Grannis electric vehicle manufacturing interests in the American Electric Car Company, of Saginaw, Mich. The latter concern proposes to continue the making of all three models of the merged companies at the same factories as hitherto. The direct benefits obtained through the consolidation are increased operating economy and a strengthening of the marketing facilities of the agents of all three original companies through the completeness of the three lines as a whole.

Electric Lamp Manufacturer Doing a Good Business.—The following abstract from a letter written by R. W. Littell, of the Kentucky Electrical Company, Owensboro, Ky., contains matter of interest bearing on the recent entry of that concern into the tungsten-lamp manufacturing field. Mr. Littell says: "Early in the fall of 1913 we decided to go into the manufacture of drawn-wire tungsten lamps, and accordingly placed our order for a complete outfit of machinery for this purpose. Since then the machinery has been installed and we are now producing the lamps. Our present capacity is 1000 lamps a day, but orders are coming in so liberally and the business outlook is so good that we do not expect to be able to meet the demand for these lamps without increasing our capacity."

Turbine Manufacturer Secures Important Rights.—The mixed-pressure turbine-regulator patent rights which have recently been acquired by the Terry Steam Turbine Company, Hartford, Conn., are one step forward in the development of the Terry turbine. The company is preparing to furnish its new "return-flow" turbine in sizes from 75 hp to 1000 hp either for straight high-pressure or low-pressure service or for automatically controlled, mixed-pressure service. The mixed-pressure turbines are of advantage in connection with existing plants, where, by their operation, the energy contained in the exhaust steam may be utilized throughout the year, instead of for a period of six or seven months, as is the case at present when the exhaust is used for heating service.

Increase in Western Electric Sales During 1913.—Sales of the Western Electric Company for the year 1913 were approximately $78,000,000, an increase of about $6,000,000, or 8 per cent, over the 1912 sales of $71,727,329. In 1911 sales amounted to $66,211,957. Business in 1913 was pretty close to the estimate made at the beginning of the year. As result of business activity and unusual conditions in the Middle West due to floods, orders in the early part of the year ran at a much higher rate than that shown for the full year, but in the latter half of the period business fell off very considerably. The company added upwards of 4000 customers last year, bringing the number to approximately 36,000. The increase in business was quite general with customers of the various classes, sales being made to the Bell companies and telephone concerns outside of the Bell system, as well as many thousands of customers for electric light supplies. The increase in business applies to central stations and also contractors, despite the decrease in building during the last year, but there was a slight falling off in the business with railways. The export business of the Western Electric Company in 1913 was the largest in the history of the company, notwithstanding the conditions in Mexico.

First of the Series of Public Utility Lectures in New York.—In the Feb. 14 issue of the *Electrical World* note was made of a series of lectures on public utility matters to be given at the West Side Branch of the Young Men's Christian Association, in New York City, under the auspices of its finance forum and with the backing of leading financial interests in the field covered. The first meeting will be held at 8 p. m. on Monday, March 9, at which time T. C. Martin, secretary of the National Electric Light Association, will speak on the "Magnitude of the Electric Light, Power and Transportation Business." Other topics which it is expected to cover in the series of ten lectures, speakers for which will be announced at a later date, are "Magnitude of the Gas Business," "Financial Requirements of Public Utilities," "Future of Public Regulation of Utilities," "Result of Regulation of Public Utilities in Wisconsin," "Public Utility Franchises and Economics," "Municipal Ownership of Public Utilities," "Progress of the Science of Lighting," "Industrial Application of Electricity," "Centralization of Power Supply," "The Public, the Investor and the Holding Company," and "Treatment of Public Utilities by the Public to Secure the Best and Cheapest Service." The speakers on these topics are being invited to express their individual and impartial views, to which neither the finance forum nor the advisory committee will be committed.

Copper Statistics for 1913.—Some interesting figures on the copper situation in the United States during 1913 have been recently compiled and the following summaries and deductions may be of value to users of that metal in the electrical industry: The production of copper in this country during the above year was 612,000 tons, of which 200,000 tons is credited to Arizona and 140,000 tons to Montana. Michigan and Utah contributed more than 75,000 tons each. Domestic deliveries for the same period came to 349,000 tons and export deliveries to 395,000 tons. The last six months each year for the past five years have shown the greatest activity in consumption both foreign and domestic. The largest importers of American copper during 1913 were Germany with 145,500 tons, France with 65,800 tons, Holland with 77,100 tons and England with 55,600 tons. A total of 180,000 tons of copper was imported by the United States in 1913. Since 1860 copper prices have varied from 55.00 in 1864 to 9.00 in 1894 and

the average price for the last thirty years has been 13.84½. In 1913 the average price for Lake was 15.70, for electrolytic 15.52, for casting 15.33 and for standard 15.07. Judging from the behavior of prices during past years and from the present outlook it seems likely that the average price of copper for the year 1914 will be not much over the thirty-year average given above.

The Foreign Agent in Brazil.—Continuing the subject treated in the issues of Feb. 21 and 28, the following data on Brazilian commercial customs may be of interest to firms planning to export electrical goods to that country: There is no federal license tax on commercial travelers in Brazil, but there is a system of registration which it is necessary to comply with, if the agent expects to effect any sales, in order to secure the protection of the courts in the enforcement of contracts. All Brazilian commercial houses have to be registered, and the foreign agent can sometimes secure protection by allying himself with one of these houses, through which, in that case, the goods must be handled. The various state and municipal governments have, however, license fees which are levied on foreign agents, and since these fees are widely variant and change frequently, the agent is safest in seeking early information from the American consulate in each territory visited. In some places a penalty attaches to commercial operations not covered by a local license. A power of attorney is almost universally necessary in Brazil if the agent himself is to receive payment for goods sold. Agents' samples can be imported duty free, for a maximum period of twelve months, on special application and the furnishing of a bond to secure the amount of duty in case of failure to re-export. As an alternative to furnishing a bond, the duty may be paid and a refund of 90 per cent secured on the re-exporting of the goods.

General Electric Apparatus for Industrial Plants.—A number of large industrial plants are represented in the latest report on sales of electrical apparatus by the General Electric Company. The New England Box Company, Winchester, N. H., is installing electric drive in its plant at Concord, N. H., and the equipment includes eighty-one motors ranging from 1 hp to 50 hp, three transformers, switchboard, switches and accessories. The Independent Envelope Company, Indianapolis, Ind., will install electric drive equipment consisting of a 75-kva generator with a 6-kw exciter, two 5-hp and six 10-hp motors and switchboard equipment. The Cherokee Brick Company, Raleigh, N. C., will install for electric drive in its plant seven motors ranging from 5 hp to 250 hp, transformers and switchboard apparatus. The Racine Rubber Company, Racine Junction, Wis., will place in operation in its plant 100-hp and 200-hp induction motors, a 200-kva synchronous condenser and switchboard apparatus. The Timber Butte Milling Company, Butte, Mont., will install in its mills twenty motors ranging from 7½ hp to 75 hp, a 5-kw motor-generator set and oil switches. The Riverside Portland Cement Company, Riverside, Cal., has ordered for its mill three 15-hp and one 200-hp motor. The Three Forks Portland Cement Company, Trident, Mont., has arranged to install seven motors ranging from 25 hp to 200 hp, two 30-kva transformers and a switchboard. The Endicott-Johnson Company, Lestershire, N. Y., will add to the electric drive equipment in its shoe factory two 7½-hp, two 35-hp and three 50-hp motors recently ordered. The American Cement Plaster Company, Lawrence, Kan., will equip its plant at Acme, Tex., with electric drive and has ordered twenty motors ranging from 3 hp to 25 hp, with switches. The International Portland Cement Company, Spokane, Wash., will install two 150-hp motors and starting compensators. The Crescent Portland Cement Company, Wampum, Pa., has ordered a 200-hp, 480-volt synchronous motor. The steel and iron industries are particularly large users of this company's apparatus and some of the recent large purchasers in that field are given in its latest report. The Bergen Point Iron Works, Bayonne, N. Y., have recently placed contracts for considerable electrical apparatus for mill equipment, comprising eight 110-hp to 125-hp mill-type motors with control equipments, thirty-six smaller motors ranging from 25 to 100 hp, 120 two-motor coal car equipments, sixteen transformers ranging from 50 to 425 kva, switchboards, switches and accessories. The Atlanta Steel Company, Atlanta, Ga., will add to the electrical equipment in its power house a 500-kw synchronous motor-generator set and switchboard. The Bethlehem Steel Company, South Bethlehem, Pa., will place in operation in its mills a large 3000-hp induction motor, switchboard and accessories. The Pennsylvania Steel Company, Philadelphia, Pa., will install in the power house of its plant at Steelton, Pa., a 500-kw motor-generator set. The Jeanesville Iron Works Company, Hazleton, Pa., will add to the electrical equipment of its plant a 300-hp motor recently purchased. The Alleghany Steel Company, Brackenbridge, Pa., has ordered two 12-hp and four 40-hp motors.

Electric-Vehicle Prospects Reported Bright at Chicago Meeting.—At the meeting of the Chicago Section of the Electric Vehicle Association on Feb. 24, Vice-chairman D. C. Arlington, of the Philadelphia Storage Battery Company, presided. He is the statistician of the section and stated that the sale of twenty-three electric commercial vehicles in Chicago had been reported since Jan. 1. The total number of electric commercial vehicles in service or on order in Chicago is now put at 757, and the number of pleasure cars at 2000. C. A. Street, general sales manager of the Walker Vehicle Company, gave an informal report of a recent trip to Philadelphia. The electric vehicle section in that city has had two or three meetings and, although the youngest of the geographical sections, is doing excellent work. Edwin E. Witherby, Western manager for the General Vehicle Company, gave some observations on the result of a recent Western trip. He said the outlook for the electric-vehicle business in 1914 is very good indeed. The electric-utility companies are waking up to the importance of this branch of the business and are taking hold of the subject in a most encouraging way. Fred L. Morgan, of Jackson, Mich., sales manager for the Standard Car Manufacturing Company, was asked to say a few words as a representative of the pleasure-car manufacturers. Mr. Morgan said that the company with which he is connected has safely weathered its difficulties of last year, which were legal rather than financial, and it feels highly encouraged over the outlook. He told of a plan of advertising the electric automobile by the co-operation of the electric-service company, the Standard company supplying "letter inserts" which a number of the central-station companies sent out with their monthly bills. Mr. Morgan has had much correspondence with electric-service companies in carrying out this method of advertising, and reports that almost without exception the central-station men expressed a desire to co-operate heartily with the electric-vehicle manufacturers. There was some informal discussion as to the result of the introduction of the Ford electric car in the field, and the unanimous opinion of the gentlemen present was that the result would be beneficial. The opinion was expressed that anything that brings the electric vehicle into greater prominence is good for all concerned, and therefore Mr. Ford, with his experience as a manufacturer of low-priced gas cars and his wide resources, will be welcomed as a manufacturer of electric automobiles.

NEW YORK METAL MARKET PRICES

	Feb. 24 Bid	Feb. 24 Asked	Mar. 3 Bid	Mar. 3 Asked
Copper:				
Standard spot*	13.75	14.37½	13.50	14.25
	Selling Prices		Selling Prices	
	£ s. d.		£ s. d.	
London, standard, spot*	64 12 6		64 2 6	
Prime Lake	14.75 to 14.87½		14.62½ to 14.87½	
Electrolytic	14.50 to 14.60		14.37½ to 14.50	
Casting	14.30 to 14.40		14.25 to 14.35	
Copper wire base	15.75 to 15.87½		15.50 to 15.75	
Lead	4.00		4.00	
Nickel	40.00 to 45.00		40.00 to 45.00	
Sheet zinc, f.o.b. smelter	7.25		7.25	
Spelter, spot	5.40 to 5.50		5.32½ to 5.35	
Tin, spot	38.50 to 39.00		37.90 to 38.25	
Aluminum:				
Prompt delivery	18.50 to 18.75		18.50 to 18.75	
Future	18.50 to 18.75		18.50 to 18.75	

***OLD METALS**

Heavy copper and wire	13.75	13.75
Brass, heavy	8.87½	8.87½
Brass, light	7.87½	7.87½
Lead, heavy	4.05	4.05
Zinc, scrap	4.25	4.25

***COPPER EXPORTS**

Total tons to March 3 967

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Georgia Railway & Power Company Matters.—The Georgia Railway & Power Company reports for 1913 gross earnings of $5,350,995, net of $2,663,322, and a balance of $594,865, after paying interest charges of $839,230, taxes of $436,095, rental dividends of $801,168 and charges of $95,590 to sinking fund. President Arkwright states that the Tallulah Falls development will be completed by April 1. The company's title to the water-power at these falls has been settled by the Supreme Court of Georgia.

Receiver for the North Electric Company.—An involuntary petition in bankruptcy asking for a receivership for the North Electric Company was filed by five creditors of the company on Feb. 5. The Western Electric Company was the largest of the petitioning creditors. The North Electric Company has manufactured telephone apparatus for a number of years, its office being in Cleveland, Ohio, and its factory in Galion, Ohio. C. H. North was the president, Garrison Babcock the vice-president and George C. Steele secretary and treasurer. Mr. Babcock issued a circular on Feb. 7 in which he said that the company had been placed in the hands of a receiver and that a proceeding in bankruptcy was pending against it. The co-operation of creditors was asked in order to carry out a plan of reorganization.

Large Electrical Manufacturers Consolidated.—The National Carbon Company, of Cleveland, Ohio, and the American Ever Ready Company, of New York City, have been consolidated, and the latter firm will be known as the American Ever Ready Works of the National Carbon Company. Conrad Hubert, president of the Ever Ready Company and recently elected vice-president and director of the National Carbon Company, stated to an *Electrical World* representative this week that the consolidation had been effected without any important financing, and that the main advantage secured by it is the provision of extra manufacturing and storage facilities for both companies. The American Ever Ready Works have a factory on the Pacific Coast, which will be of large advantage to the National Carbon Company, and the Toronto factory of the latter concern will be of advantage to the former company. It is understood that the combination has involved no organization changes other than those affecting Mr. Hubert, and that the identity of the organization, product and sales system of each company will be preserved intact. Another advantage of the merger will be the joining of patent rights.

Annual Report of the Public Service Company of Northern Illinois.—At the annual meeting of the stockholders of the Public Service Company of Northern Illinois, held in Chicago on Feb. 24, President Samuel Insull reported for the year 1913 gross earnings of $6,066,825, and net earnings of $2,476,725, from which was paid interest on notes and bonds amounting to $1,307,399. Dividends to the amount of $455,276 were paid on preferred stock and $385,327 on common stock, and $207,694 was carried to surplus. During the year the company's outstanding bonds and notes were increased by the amount of $4,118,000. This is due to the consolidation with the Northwestern Gas Light & Coke Company, to the acquisition of the plant of the Pontiac Light & Water Company, and to the addition of a 7500-kw unit in the Blue Island generating station, a 5000-kw unit in the Waukegan station, and other plant extensions. During the year the directors increased the annual dividend rate upon the common stock from 4 per cent to 5 per cent. A service annuity system for faithful employees was put into effect on Dec. 1. It is administered by a committee consisting of President Insull, Secretary John H. Gulick, Vice-president Frank J. Baker, Vice-president Charles A. Munroe and General Superintendent George H. Lukes. The company has also established an employees' saving fund. The company's connected business, exclusive of railway power business, amounted to 1,837,630 50-kw equivalents on Dec. 31, 1913. This shows an increase of 369,024 units during the year. The company has thirteen electric generating stations operated by steam or water-power, thirty-five electric substations, nine gas-generating plants and five heat-generating stations. It has issued $17,734,500 of capital stock, has a funded debt of about $28,000,000 and its total assets amount to $48,518,630.

Financial Statement of the Electric Bond & Share Company.—The financial statement of the Electric Bond & Share Company, as of Dec. 31, 1913, contains figures of interest regarding that concern's activities. Current assets amount to $2,882,646, of which $1,217,729 represents cash on hand and in banks. The item of syndicate holdings, underwritings and advances shows assets of $4,180,703, and the investments of the company come to a total of $9,313,478. Under the head of liabilities the company has an outstanding common stock of $5,000,000 and preferred stock of $4,800,000. Its current liabilities amount to $1,348,812, syndicate and contingent liabilities to $1,939,303, reserves to $101,000, and surplus to $3,187,713.

Submarine Signal Company's Progress.—The Submarine Signal Company, Boston, Mass., reports rapid progress in its business development in the past six years. The total number of ships now equipped, or on order for equipment, is 1151, compared with 412 at the end of 1908. The number of signal stations increased from 40 in 1908 to 166 throughout the world in 1913. Several submarine boats have lately been equipped with sending apparatus, and the outlook is bright for communication between vessels in fog and storm by this means in the near future. The company has perfected an invention for "speeding up" the sending of messages by the submarine bell by the use of the Morse code. Its 1913 business was the best in its history.

New England Power Company Prospering.—President George S. Smith of the New England Power Company, Boston, Mass., states in his annual report covering the year 1913 that the gross income of the property was $778,000 as against $514,000 in 1912; that net earnings were $427,000 as against $324,000, and that the balance, after paying bond interest and sinking fund, was $167,000 on Dec. 31, compared with $150,000 a year before. A surplus remained above guaranteed dividends, note interest and other charges, despite the fact that the company's Somerset Reservoir in southwestern Vermont was not completed, that the season was the driest on record in New England for twenty years, and that many parts of the transmission system were not completed until late in November. With the Somerset Reservoir and transmission lines now available, it is expected that earnings for 1914 will be materially increased, and with the development of Plant No. 5, in the Hoosac Tunnel district of Massachusetts in the coming fall, still further gains are anticipated. During 1913 three plants were placed in operation on the Deerfield River near Shelburne Falls and have proved in every way satisfactory. They were initially operated at a disadvantage on account of the incomplete condition of the Somerset Reservoir and prior to the completion of the 110,000-volt transmission line to Millbury, Mass., in the Worcester district, and to the Berkshire section of the State. During the year a contract was made with the Narragansett Electric Lighting Company, of Providence, R. I., the second largest central-station organization in New England. Under this contract power will be supplied on reasonable terms, furnishing the energy required by large power users in the Providence district, and also a large amount of secondary power to the company itself, whose steam plant will be available under reciprocal agreement for the supply of auxiliary power in reserve. By purchase of the water rights on the Deerfield River immediately above Plant No. 5, the company will develop a head of 240 ft. at little additional construction cost. When this plant is completed the development on the Deerfield River will total about 55,000 hp, and the company owns rights on this stream permitting a still further production of hydroelectric energy. For 1914 no new construction work is planned except a gradual increase of the transmission line mileage in the territory now served and the completion of the No. 5 station. The power station building is already constructed and is now used as a transforming station for the electrical energy delivered to the Boston & Maine Railroad for the operation of trains through the Hoosac Tunnel. With the completion of the present developments, the system will be one of the largest in the country, serving a territory producing about 25 per cent of the value of all articles manufactured in the United States, and a region in which the price of coal is higher than in any other extensive manufacturing region in this country.

Business Notes

Westinghouse, Church, Kerr & Company, of 37 Wall Street, New York City, have established a laboratory for the purpose of testing concrete aggregates, water-proofing materials, paints and preservative coatings for steel and concrete.

The Rateau Steam Regenerator Company, of 410 Cedar Street, New York, has recently announced the sale by it to the Terry Steam Turbine Company, of Hartford, Conn., of a license to manufacture and sell, in connection with its product, the Rateau patented mixed-pressure turbine regulator.

The National Lamp Works of the General Electric Company have secured the services of Van Rensselaer Lansingh as manager of the recently created department devoted to the manufacture and sale of both glass and metal reflectors. Mr. Lansingh will have his office at the National Lamp Works, Nela Park, Cleveland, Ohio.

The Stone & Webster Engineering Corporation, of Boston, Mass., has appointed L. E. Palmer as advertising manager with headquarters in Boston. Mr. Palmer is a graduate of Cornell University, receiving the A. B. degree in 1905, and for the past two years has been assistant to Barrett Smith, advertising manager. Prior to his connection with Stone & Webster, Mr. Palmer was on the editorial staff of *The Survey*, New York City.

Pope's Electric Lamp Company, Ltd., of Hythe Road, Willesden, England, has recently completed extensive additions to its works which will enable it to fill orders for all sorts of carbon or "Elasta" lamps far more promptly. Besides supplying its "Elasta" wire lamps, which have been a most remarkable success owing to the strength of the filament and the economy of the lamp, this company is also in a position to quote export prices for drawn-wire lamps, and therefore will welcome inquiries for both types of lamps.

Barrett Smith has opened an office for the practice of advertising and advertising management at 20 Central Street, Boston, Mass., following five and one-half years' service at the head of the advertising department of the Stone & Webster Engineering Corporation. Prior to his connection with Stone & Webster Mr. Smith was associated with J. G. White & Company, Inc., New York, as advertising manager, and with Mackenzie & Company, Ltd., of Shanghai, China, as mechanical and constructing engineer. He was educated at Cornell University, graduating from the College of Mechanical Engineering in 1904.

New Industrial Companies

The Cresson Electric & Machine Company, of Philadelphia, Pa., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $20,000. L. A. Brownhill, of Wilmington, Del., is one of the incorporators.

The Hercules Electric Company, of Indianapolis, Ind., has been incorporated with a capital stock of $25,000 to manufacture and deal in electrical supplies. The directors are K. B. Kurtz, S. H. Kurtz, C. D. Meier, John H. Holliday and Albert Baker.

The E. A. Koeneman Electric Company, of St. Louis, Mo., has been incorporated with a capital of $12,000 by E. A. Koeneman, Charles Koeneman, Henry I. Chaplin and Harry Wibracht. The company purposes to manufacture electrical machinery, appliances, etc.

The General Vacuum Cleaner Company, of New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture and deal in vacuum-cleaning apparatus. The incorporators are L. W. Thompson and H. M. Dynan, of New York, N. Y., and K. M. Devitt, of Brooklyn, N. Y.

The Stanley Utilities Company, of New York, N. Y., has been incorporated by Charles H. Stanley, 600 West 157th Street, New York; Cynthia Stanley and Frank Hauser, of New York. The company is capitalized at $10,000 and purposes to deal in mechanical, electrical and chemical appliances.

The Dwyer Wireless Telephone Company, of New York, N. Y., and San Francisco, Cal., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $10,000,000. The company proposes to conduct a wireless telegraphy, telephony and aerophony business and to construct buildings, stations, etc., for that purpose. The incorporators are Max Oschler, Samuel H. Loveless, Sydney M. Oschler and Antonio C. Montgomery, all of New York, N. Y.; Harry P. Dwyer, George Hough Perry, William H. Schooler and Lloyd Michels, all of San Francisco.

Trade Publications

Sockets.—Lock sockets made by the Best Electric Company, Pittsburgh, Pa., are illustrated and described in a small folder recently issued by the company.

Fans.—Catalog 14-F contains illustrated descriptions of the 1914 models of fans manufactured by the Menominee Electric Manufacturing Company, Menominee, Mich.

Turbo Air Pump.—The Wheeler Condenser & Engineering Company has issued a double-page circular giving the results of recent tests on its turbo air pump. The tests showed 99.3 per cent of the theoretical vacuum at the turbine exhaust.

Oil Engines.—Types "C" and "E" of the Primm oil engine are described and fully illustrated in Bulletin No. 3, issued by the Power Manufacturing Company, Lima, Ohio. These engines are of the horizontal, single-cylinder, two-cycle cross-head construction.

Meters.—For inclusion with other loose-leaf trade literature recently sent out, the Esterline Company, Indianapolis, Ind., is mailing additional leaflets, some giving the new discounts and others containing dimensions of different classes of its apparatus.

Drawbridges.—A twelve-page bulletin, No. 143, has been issued by the Electric Storage Battery Company, Philadelphia, Pa., devoted to brief descriptions of some of the latest types of electrically operated drawbridges equipped for storage-battery operation. Some interesting examples of recent installations are illustrated.

Electrical Apparatus for Automobiles.—The Remy Electric Company, of Anderson Ind., has issued a pamphlet describing the activities and products of the reorganized Remy company. This company manufactures starting, lighting and ignition devices, and says that it is the largest concern in the world exclusively devoted to the manufacture of electrical apparatus for automobiles and locomotives.

Cranes.—A fully illustrated catalog of sixty-two pages, known as Crane Catalog No. 26, is being distributed by the Northern Engineering Works, Detroit, Mich. This is a compilation of several of the company's bulletins that more fully describe the various classes of cranes made by the Northern Engineering Works. The simple and efficient arrangement of the crane mechanism is clearly shown in the pictures.

Drilling and Boring Machines.—A pamphlet entitled "Difficult Drilling and Boring Made Easy" has been published by the Pawling & Harnischfeger Company, of Milwaukee. It describes and illustrates the use of Pawling & Harnischfeger horizontal drilling and boring machines. Many interesting examples of work done by these machines in various manufacturing establishments are given. One claim made for these equipments is the ease of handling work.

Meters.—The mercury type direct-current watt-hour meters manufactured by the Sangamo Electric Company, Springfield, Ill., are the subject of Bulletin No. 37. In this unusual thirty-two-page pamphlet the story of the meter is told in a succinct, interesting manner. From the opening paragraph, with its clear presentation of the central station as an energy-manufacturing plant, to its closing data on train ratios and disk constants for two-wire D-5 meters, this bulletin will be found most instructive. The diagrams and halftone illustrations are well chosen and form a fitting accompaniment to the text.

Personal Mention

Mr. H. M. Buck has resigned as manager of the Waukesha (Wis.) Gas & Electric Company.

Mr. George H. Holt has been elected president of the Oconto (Wis.) Electric Company as successor to Mr. W. H. Young.

Mr. E. W. Moser, who has been superintendent of the Lehighton (Pa.) Electric Light & Power Company, has resigned to engage in business for himself.

Mr. C. Rodman Stull, formerly of Bangor, Maine, has been appointed manager of the Waukesha (Wis.) Gas & Electric Company, vice Mr. H. M. Buck, resigned.

Mr. D. C. Green, of Marshfield, Ore., has been appointed general manager of the Everett (Wash.) Gas Company, which controls the electric supply in Snohomish and Monroe.

Mr. Hugh M. Wilson, first vice-president of the McGraw Publishing Company, Inc., who has been in poor health for some months, sailed on the S. S. *Minnewaska* on Feb. 28 for an extended trip in Europe.

Mr. A. H. Kublich, of Drifton, Pa., recently employed by the General Electric Company, has been appointed superintendent of the Lehighton (Pa.) Electric Light & Power Company, vice Mr. E. W. Moser, resigned.

Mr. T. I. Jones, general sales agent for the Edison Electric Illuminating Company of Brooklyn, and chairman of the Commercial Section of the N. E. L. A., sailed for Europe on Feb. 28 on the S. S. *Carmania*, to be absent three weeks.

Mr. Francis E. Donohoe, formerly of the American Electrical Works, New York City, resigned on Feb. 1 to become associated with the National Conduit & Cable Company and the National Brass & Copper Tube Company, with headquarters at 41 Park Row, New York.

Mr. Albert E. Winchester, well known as superintendent of the municipal electric plant at Norwalk, Conn., has been selected by the Public Utilities Commission of Connecticut and by the Stamford Gas & Electric Company to make an investigation into the lighting system in Stamford.

Mr. W. F. Albright has been appointed superintendent of the electrical department of the Citizens' Light, Heat & Power Company, of Johnstown, Pa., succeeding Mr. A. Weiss, who was made assistant to the general manager. Mr. Albright was formerly assistant superintendent of the company.

Mr. John H. Gulick, of Chicago, the new vice-president of the Commonwealth Edison Company, in charge of accounting, with supervision over the auditor and the auditing department, has been auditor of the company for a number of years. Mr. Gulick is considered an authority on the subject of electric-service organization and accounting. He is secretary and treasurer of the Public Service Company of Northern Illinois and a director in that company, and is also a director and a member of the executive committee of the Middle West Utilities Company.

Mr. Edward J. Doyle, the new secretary and treasurer of the Commonwealth Edison Company, Chicago, has been secretary to President Insull for several years and in that position has won the hearty good will of all who visit the president's office. Mr. Doyle is still a young man, but is rapidly rising into prominence in the Insull organizations. In the Commonwealth Edison Company he was promoted from the post of assistant secretary and assistant treasurer to his present position. He is also secretary of the Middle West Utilities Company and a member of the board of directors of that company.

Mr. Charles L. Edgar, president of the Edison Electric Illuminating Company of Boston, Mass., has returned from a six weeks' business and pleasure trip to the Pacific Coast, in company with Mrs. Edgar and Mr. and Mrs. L. L. Edgar. Mr. Edgar and his son were entertained at luncheon by Mr. John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, during their stay in San Francisco. The return trip was made via Los Angeles and New Orleans. At the former city a comprehensive inspection was made of the local plants and system of the Southern California Edison Company.

Mr. C. J. Franklin has resigned as general superintendent of railways of the Portland (Ore.) Railway, Light & Power Company to open an office in the Wilcox Building, Portland, as a consulting expert in all matters embracing operating problems, construction, valuations, rate situations, etc., in connection with public utility properties. During the last two years Mr. Franklin has given close attention to methods of operation and studies of details for new business, and his services upon special occasions have been retained by some of the principal public utility companies on the Pacific Coast. Previous to becoming connected with the Portland Railway, Light & Power Company Mr. Franklin passed five years with Stone & Webster at Tacoma as general superintendent of the Tacoma Railway & Power Company and the Puget Sound Electric Railway, operating between Tacoma and Seattle. Mr. Franklin went to the Pacific Coast after he had served thirteen years with the Virginia Passenger & Power Company, Richmond, Va.

Mr. Louis A. Ferguson, who by the retirement of Mr. Robert T. Lincoln becomes senior vice-president of the Commonwealth Edison Company of Chicago, will have charge of the contract, operating and construction departments. Mr. Ferguson is one of the best-known central-station men in the country. He was born in Dorchester, Mass., in 1867 and graduated in electrical engineering from the Massachusetts Institute of Technology in 1888. He joined the staff of the Chicago Edison Company in the same year and has been with that company, or its successor, ever since. He was first engineer of the underground department and thereafter electrical engineer and general superintendent, becoming second vice-president in 1902. Mr. Ferguson enjoys the unique distinction of having been president of three of the great technical, or semi-technical, societies of the United States. He was president of the Association of Edison Illuminating Companies for two terms, from 1901 to 1903; president of the National Electric Light Association for one term in 1902-1903, and of the American Institute of Electrical Engineers for one term in 1908-1909. Mr. Ferguson is a director in several commercial organizations and a member of a large number of clubs and societies.

LOUIS A. FERGUSON

Mr. E. C. Deal has resigned as vice-president and general manager of the Augusta-Aiken Railway & Electric Corporation of Augusta, Ga., and has become associated with the banking house of W. N. Coler & Company of New York City, which controls and operates a number of electric railway, lighting, gas and water properties. Mr. Deal gained his early experience with the Georgia Electric Light Company, which he served in various capacities from 1894 to 1898. He then entered the employ of Stone & Webster, of Boston, Mass., and left them in 1904 to go with the Gas & Electric Company of Bergen County in New Jersey as chief engineer in charge of the company's properties in more than forty municipalities in northern New Jersey. When that company was absorbed by the Public Service Corporation of New Jersey Mr. Deal became superintendent of the electric properties in central New Jersey. He severed his connection with the Public Service Corporation in 1908 to go with W. N. Coler & Company as manager and engineer of public service properties owned by them. Following the acquisition of the property of the Augusta Railway & Electric Company and the Augusta-Aiken Railway & Electric Company by a syndicate in which J. G. White & Co., Inc., of New York City were interested, Mr. Deal resigned from Coler & Company to become manager of the Augusta-Aiken Railway & Electric Corporation, the successor company in Augusta. This was in April, 1911. In April, 1913, he was elected vice-president of the company in addition to general manager. Mr. Deal is fourth vice-president of the National Electric Light Association and is a past-president of the Southeastern Section of the National Electric Light Association.

Construction

New England

BIDDEFORD, MAINE.—The Cumberland County Pwr. & Lt. Co. has acquired a right-of-way for a pole and tower transmission line from Dunstan to Biddeford, a distance of about 7 miles.

PRESQUE ISLE, MAINE.—Permission, it is reported, has been granted to the Maine & New Brunswick El. Pwr. Co., of Presque Isle, by the county officials of Woodstock County, New Brunswick, to erect a 30,000-volt transmission line through the township to Woodstock. The company proposes to furnish electricity generated at its plant at Aroostock Falls, N. B., in Woodstock, and also in towns along the route of the new transmission line. C. O. Austin, of Presque Isle, is superintendent.

McINDOE FALLS, VT.—The McIndoe Falls Electric Light Plant was recently reorganized, and it is now known as the McIndoe Falls Lt. & Pwr. Co. Don L. Judkin is president and J. M. Gibson is secretary and treasurer.

TURNERS FALLS, MASS.—The contract for the new canal (2 miles long) to Montague City, plans for which have been under way for four years, has been awarded by the Turners Falls Co. to the Holbrook, Cabot & Rollins Co., of Boston, Mass. The work involves excavation, concrete work, with cofferdam work, sewer, road and embankment building. Fred T. Ley & Co., of Springfield, were awarded the contract for power house foundations.

WESTFIELD, MASS.—The electric light commissioners have awarded the contract for new turbine and alternator to the General Electric Co., at $11,728; the Alberta Pump and Condenser Co. was awarded the contract for pump and condenser, for $4,010. Contract for steam piping and foundations will be awarded later.

STAMFORD, CONN.—The Stamford Gas & El. Co. expects to install a short section of underground distribution system. G. B. Leland is superintendent.

Middle Atlantic

ALBANY, N. Y.—Contracts have been awarded by the Board of Supervisors in connection with the new court house as follows: For time clocks and fire-alarm system to the Standard El. Time Co., of New York, at $2,476; for elevators to the Otis Elevator Co., New York, for $21,942, and for electrical work to F. W. Newman & Son, of Albany, at $18,333.

BATH, N. Y.—At the annual charter election, to be held this month, the proposal to appropriate $50,000 for the installation of a municipal electric-light plant will be submitted to the voters.

PERRY, N. Y.—Arrangements have been made by the Perry El. Lt. Co. for installation of a new street-lighting system. A contract has been placed for nitrogen incandescent lamps.

SYRACUSE, N. Y.—Bids will be received by the trustees of the New York State College of Forestry, Syracuse University, Syracuse, N. Y., until March 21 for construction, heating and ventilation, plumbing and gasfitting and electric work for the New York State College of Forestry, Syracuse University, Syracuse, N. Y. (readvertisement). Bids will be received for each division of the work separately and no combination of bids will be received. Drawings and specifications may be consulted and blank forms of proposal obtained at the office of the dean of the New York State College of Forestry at Syracuse, and at the office of Lewis F. Pilcher, Capitol, Albany, where complete sets of plans and specifications may be obtained upon deposit of $10, to be refunded upon return of same.

ALLENTOWN, PA.—Bids will be received by Cyrus J. Dilcher, county controller, Allentown, until March 19, for furnishing material and construction of an addition to the Lehigh County court house, Allentown, as follows: Item A—For construction of addition, exclusive of plumbing, heating, ventilating and electric work; alternate proposal for the entire addition, including plumbing, heating, ventilating and electric work; B—for plumbing work complete; C—for heating work complete; D—ventilating work complete; E—electric work complete. Plans and specifications are on file in the office of the county commissioners, Allentown.

CATAWISSA, PA.—At a special election to be held March 19 the proposal to sell the municipal electric-light plant at a minimum price of $12,000, or to issue bonds to the amount of $8,500 to remodel the plant to enable it furnish adequate electrical service for the borough, will be submitted to the voters.

DUBOIS, PA.—The power house at the Dubois shops of the Buffalo, Rochester & Pittsburgh Ry. Co., it is reported, will be enlarged and additional machinery installed.

HAZLETON, PA.—The Shenandoah Lt., Ht. & Pwr. Co. plans to make various improvements to its system in the spring. J. S. Wise, Jr. is general manager.

PHILADELPHIA, PA.—Mayor Blankenburg has decided to advertise for bids for lighting the streets with electricity in 1915 at once.

PHILADELPHIA, PA.—Plans have been filed by the William Steele & Sons Co., contractors, for the erection of a three-story factory building and power house for H. G. Fetterolf & Co., to be erected at Stenton Avenue and Louden Street.

PHILADELPHIA, PA.—Bids are being received by E. A. Wilson, architect, 1208 Chestnut Street, Philadelphia, on the electrical work on new apartment houses to be erected at Nineteenth Street and Erie Avenue, Philadelphia, at a cost of $260,000.

PHILADELPHIA, PA.—The contract for the construction of a three-story brick and terra-cotta school building, to be erected at Forty-seventh and Locust Streets, has been awarded to Cramp & Co., 801 Denckle Building, Philadelphia, at $159,537. Sub-contracts as yet have not been given out.

PHILADELPHIA, PA.—The contract for the new store building to be erected at Broad and Laurel Streets, Hazleton, for Gerhardt & Friedlander, has been awarded to S. Y. Fredericks & Sons, of Hazleton. A combination gas and electric-lighting system will be installed for which contract has not been awarded.

PHILADELPHIA, PA.—The contract for the erection of the new 18-story building for P. A. B. Widener, to be erected at Broad and Chestnut Streets, has been awarded to the George A. Fuller Co., Morris Building, Philadelphia. The sub-contract for a private electric system which is to be installed has not yet been let.

RIDGWAY, PA.—The Ridgway El. Lt. Co. is contemplating increasing its generating equipment. C. H. Law is general superintendent.

SHARPSVILLE, PA.—The City Council has granted the Shenango Valley El. Lt. Co., of Sharon, a contract for lighting the streets of the city for a period of five years. The company will furnish 80-cp tungsten lamps at $23 per year.

STATE COLLEGE, PA.—John W. Emery, 1524 Sansom Street, Philadelphia, is estimating on revised plans and specifications for the electrical work for the Liberal Arts Buildings, to be erected at State College, Pa.

WERNERSVILLE, PA.—The Wernersville & Heidelberg El. Lt. & Pwr. Co. expects within the next three months to erect a high-tension transmission line about 5 miles long. The material for this installation has been purchased. Robt. W. Wertz is president.

WILKES-BARRE, PA.—The City Council has passed an ordinance granting the Wilkes-Barre Lt. Co., a new company, a franchise to furnish electricity in Wilkes-Barre.

CAPE MAY COURT HOUSE, N. J.—The Vulcan El. Lt., Ht. & Pwr. Co., 915 Real Estate Building, Philadelphia, Pa., is asking for bids for the construction of a brick power station (electric) and for building 4 miles of electric railway in Cape May Court House.

ELIZABETH, N. J.—The township committee of Hillside is planning for the extension of the lighting system throughout the township, including the Lyons Farms and Saybrook sections.

FREEHOLD, N. J.—Bids will be received by the board of chosen freeholders of Monmouth County, Court House, Freehold, N. J., until March 11, for furnishing materials, lamps and electricity for lighting the bridges in the townships of Ocean, Shrewsbury and Middletown. The bridges to be lighted are: Seabright bridge, Oceanic bridge, Goose Neck bridge, Cooper's bridge, Hubbard's bridge, Locust bridge, Gibbon's bridge, Shepherd Knapp bridge, Newman Springs bridge, Oceanport bridge, O'Hagan's bridge and Mount's Corner bridge. Specifications as to the number, character and location of lamps can be obtained from John M. Corlies, freeholder, Rumson, or of John Daly, freeholder, Long Branch, N. J.

MAPLEWOOD, N. J.—The township committee has awarded a contract for street lighting to the Public Service El. Co. for a period of five years. The present system comprises about 400 incandescent lamps.

MERCHANTVILLE, N. J.—The borough council has received estimates for the installation of a municipal electric-lighting plant to cost $17,400. The plant considered would provide energy for about 400 40-cp lamps.

PRINCETON, N. J.—The lighting committee of the City Council is planning to install new street lamps in different sections of the city.

RAHWAY, N. J.—The Common Council has appointed a committee to investigate the proposition of a municipal electric lighting plant.

TRENTON, N. J.—The contract for electrical equipment in the new store building of H. M. Voorhees & Brothers at East Trenton Street, Trenton, has been awarded to J. P. Kelly, of Trenton.

MANNINGTON, W. VA.—The Consumers' El. Lt. Co. has established a day service for lamps and motors. The service began March 1.

RAVENSWOOD, W. VA.—Within the next four or five months the municipal electric-lighting plant plans to erect some new poles and lines over the town, and to purchase generators, gas engines and pumps. C. O. Nilsson is superintendent.

CLIFTON, VA.—Within the next four months the Virginia Western Pwr. Co. of Clifton expects to erect 30 miles of 44,000-volt transmission lines and several substations; also to purchase six 44,000-volt transformers, varying in size from 15 kw to 200 kw.

ST. CHARLES, VA.—The El. Trans. Co., control of which was recently purchased by the Insull interests, of Chicago, Ill., it is reported, will increase the output of its plant to 35,000 hp. The company is planning to furnish energy to the coal mines in Virginia and Kentucky.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 17 for furnishing at the various navy yards and naval stations the following supplies: Boston, Mass., Schedule 6471—re-stranding and re-insulating cables. Brooklyn, N. Y., Schedule 6471—50,000 ft. incandescent lamp cord, 1100 ⅛-in. pipe, fiber-lined, polished brass key sockets; Schedule 6489—3000 ft. rubber-insulated rat-tail wire for aerials. Camden, N. J., Schedule 6477—two 50-watt talking motor generators, two telephone-ringing dynamotors, one type C-54 telephone switchboard, miscellaneous telephones. Washington, D. C., Schedule 6473—1000 5-amp receptacle plugs, 300 double and snap switch receptacles, miscellaneous electrical supplies; Schedule 6472—miscellaneous steel wire ¼ in. and 3/16 in. in diameter).

North Central

DETROIT, MICH.—The contract for electrical work in connection with the new building for the Detroit Athletic Club has been awarded to the McCleary-Harmon Co. The cost of the building is estimated at $1,000,000.

GRAND RAPIDS, MICH.—A power plant, it is reported, will be erected in connection with the new factory for the Sterling Desk Co.

IONIA, MICH.—Steps have been taken for the installation of an ornamental street-lighting system. Robert Beard is the chairman of the committee appointed to take charge of the matter.

IRON RIVER, MICH.—Work has begun on the remodeling and enlarging of the power house of the Peninsular Pwr. Co. There has been purchased for this installation one 940-kva, 60-cycle, 6600-volt turbo-generator and other necessary equipment for the extension. D. W. Mead, Madison, Wis., is engineer in charge of the work.

AKRON, OHIO.—Bids will be received at the office of C. P. Parker, director of public service, Akron, until March 23 as follows: (1) For three 150-hp water-tube boilers; (2) one fuel economizer, smoke flue, and automatic damper regulator. Specifications and plans may be seen at the office of the director or at the office of F. A. Barbour, 1120 Tremont Building, Boston, Mass.

BELLEFONTAINE, OHIO.—The only bids for the complete installation of the addition to the municipal electric-light plant was submitted by the Laroe Construction Co., of Hamilton, at $35,000.

CINCINNATI, OHIO.—The contract for furnishing material and completing the electrical work and fireproof windows and doors in the new Bloom School, at Bank and Baymiller Streets, Cincinnati, has been awarded by the board of education to

Fischer Brothers, 1046 Madison Avenue, Covington, Ky., at $12,062. C. W. Handman is business manager of the board.

GALLIPOLIS, OHIO.—The electric plant of the Gallipolis Gas & Coke Co. has been purchased by L. B. Herrington, of Richmond, Ky., who, it is said, will remodel and make extensions to same. Mr. Herrington, it is said, has made arrangements to furnish energy to the interurban railway passing through Gallipolis, and the City Council is considering a proposal for furnishing electricity for lighting the city.

MANSFIELD, OHIO.—Complete plans for the new lighting system for the city of Mansfield will be ready early in March. Nitrogen lamps, it is said, will be included in the plans. H. Whitford Jones, of Cleveland, is consulting engineer.

NILES, OHIO.—Bids will be received by J. N. Cowdery, director of public service, until March 9 for furnishing transformers, incandescent lamps and meters for the municipal electric-light plant.

LANCASTER, KY.—Application has been made to the Council by Alexander Walker and Cleveland Rose, owners of the local electric-light plant, for a new franchise. They propose to install a new electric plant.

MORRISTOWN, KY.—The Mims-Goodson Co. contemplates installing electric elevators in a six-story mercantile building for which plans are now being prepared.

FORT WAYNE, IND.—The City Council has engaged the Indiana Engineering Co. to prepare plans and specifications and superintend the construction of the addition to the municipal electric-light plant and for the installation of the new machinery. The cost of the entire work is estimated at about $75,000 and will include the installation of a new generating unit at the plant and the erection of about 40 miles of extension to the lines.

HAVANA, ILL.—The City Council is reported to be considering the question of establishing a municipal electric-light plant in Havana.

SPRINGFIELD, ILL.—A petition has been filed by the board of local improvements for the erection of an ornamental street-lighting system on Adams Street, from Lewis Street to Tenth Street. The petition asks for five-lamp standards in the business district and for three-lamp standards in the residence section.

ANTIGO, WIS.—Permission has been granted the Antigo El. Co. by the Wisconsin Railroad Commission to issue $10,000 in capital stock for additions and improvements to its plant. The company, it is understood, will install an additional boiler and larger generators to increase the output of the plant.

BAYFIELD, WIS.—The Municipal Lt., Pwr. & Wtr. Plant expects to purchase within the next month two direct-current 2300-volt, 60-cycle, three-phase generators, also a motor-driven pump and a new switchboard.

BOSCOBEL, WIS.—The Board of Electric Light Commissioners expects to purchase this spring one 150-hp boiler. Charles A. Blair is general manager.

BUTTERNUT, WIS.—Plans are being considered by W. J. Schulz for enlarging his electric-light plant to supply electricity for lighting the entire village. H. R. Wuerffel, of Chicago, Ill., consulting engineer, has been engaged to prepare estimates of costs.

FOUNTAIN CITY, WIS.—A 9-mile extension is being planned by the Fountain City Lt. & Pwr. plant, for which the equipment will be purchased within the next three months. H. & F. Roettiger are the owners of the plant.

HARTFORD, WIS.—Within the next two months the managers of the municipal electric lighting plant expect to purchase one 450-hp Corliss engine directly connected to a 300-kw generator.

MANITOWOC, WIS.—Within the next few months it is planned by the Oslo Pwr. & Lt. Co. to build a new concrete dam to replace the one that was carried away in the spring of 1913. The dam is to be 200 ft. long and have a 10-ft. head. A. O. Anderson is president.

MAUSTON, WIS.—A new street lighting system is being planned for this city, which will be purchased either by the city of Mauston or the Mauston El. Serv. Co. J. F. Carroll is manager of the service company.

MELLEN, WIS.—Within the next four months the Mellen Wtr. & Lt. Co. expects to purchase one 75-kva to 100-kva, 2200-volt, 250 r.p.m. generator; also within the next five months a 75-hp, 250 r.p.m. engine to drive generator. A. W. Pribnow is president and general manager.

OCONTO, WIS.—The Oconto Falls Water & Lt. Plant expects to purchase within the next six months a Corliss engine and a 2200-volt alternating-current 60-cycle generator. Emmett Johnson is superintendent.

PORT WASHINGTON, WIS.—The electric light commissioners expect within the next half year to purchase a carload of 35-ft. and 40-ft. poles and also some electric irons. Fred. I. Russell is superintendent.

SHEBOYGAN FALLS, WIS.—At a special election Feb. 24 to vote on the question of issuing $40,000 in bonds for the construction of water-works and $9,000 in bonds for a lighting plant, the question of water-works was defeatetd, but the proposition to build and to purchase a lighting plant was carried. The city will probably take over the local lighting plant. Ober W. Chaplin is city clerk.

WARRENS, WIS.—The George Warren Co., owner of the electric light plant here, is planning to purchase within the next year a small 220-volt direct-current generator, some wiring supplies, and also vacuum cleaners and other household devices.

WASHBURN, WIS.—The Washburn El. Lt. & Pwr. Co. has closed a contract with the Northwestern Fuel Co. for the installation of two 200-hp, 2200-volt alternating-current motors to operate its dock equipment and one 100-hp pumping outfit for fire protection, the Washburn company furnishing the energy to operate this outfit. A 15,000-volt, three-phase line will be run to the dock and an outdoor substation erected, which will consist of three 15,000 2200-volt, 150-kw transformers. It is expected that this installation will be ready for operation not later than April 15. F. W. Downs is superintendent.

WAUSAU, WIS.—The municipal electric lighting plant, which gets its energy from the Wausau St. R. R. Co., expects to purchase within the next six months 3000 ft. steel-taped three-conductor, 6-8-10 gage cable for an underground distribution system. It is also planned to purchase twelve additional ornamental posts if the City Council passes upon the installation. H. E. Marquardt is comptroller.

ELK RIVER, MINN.—Plans are being considered by Hildreth & Waterman, owners of the water-power on Elk River, to develop the water-power, if satisfactory arrangements can be made with the village for lighting the village.

FARMINGTON, MINN.—The Farmington El. Lt. & Pwr. Co. expects to install a steam-heating plant, to furnish steam heat for about four blocks, and a 100-hp to 150-hp engine and boilers; also to erect a transmission line to two adjoining towns, a total length of 12 miles. The company also proposes to change its power equipment from 220 volts direct current to 2500 volts alternating current, three-phase, with step-up transformers to 13,200 volts for other towns. F. H. Eddy is manager.

HILLS, MINN.—An election will be held March 10 to vote on the proposal to issue $8,000 for the installation of a municipal electric-light plant.

MINNEAPOLIS, MINN.—Bids will be received until March 12 for the construction of power house of the Northern Mississippi River Pwr. Co. at Coon Rapids. Plans and specifications may be secured at the office of the Minneapolis General Electric Co., Minneapolis, for which a deposit of $10 will be required, to be refunded upon return of same.

NEW GERMANY, MINN.—Arrangements are being made by A. J. Schnobrich for the installation of an electric-light plant in connection with his garage. The Council has awarded Mr. Schnobrich a contract for lighting the streets of the village. Contracts have been awarded for the machinery, which includes a gasoline engine and dynamo.

ST. CLOUD, MINN.—The city commission will soon ask for bids for an electrically driven pump for the water-works station.

WILLMAR, MINN.—Bids will be received by the City Council until March 9 for equipment for the municipal electric-light plant as follows: One 175-hp steam engine, one 125-hp steam engine, both to be equipped with all appurtenances; one 150-kva generator, one 100-kva generator, two exciters, one 9-kw and one 12-kw, and one six-panel switchboard with accessories. Specifications and plans of switchboard may be seen at the office of the city clerk, Willmar, or at the office of Joseph W. Rosche, consulting engineer, 820 Plymouth Building, Minneapolis, Minn.

CLARINDA, IA.—The Lee El. Co., of Clarinda, contemplates the erection of an office building and storeroom, to cost about $15,000 as soon as plans can be prepared. The company does all of the house wiring in Clarinda and in all of the towns served by the company. Rufus E. Lee is manager.

LITTLE ROCK, IA.—An election will be held March 16 to submit to the voters the proposal to grant the Little Rock El. Lt. Co. a franchise to operate an electric-light plant here.

SIOUX RAPIDS, IA.—The property of the Sioux Rapids Hydro El. Co., it is reported, has been purchased by K. C. Gaynor, of Sioux City, who owns the electric plants in Marcus, Ia., and Huntington, Neb. It is understood that the new owner will make improvements to the plant and service.

EUREKA, MO.—The mill and water-power owned by James Byrne, is reported to have been leased by the Missouri Pwr. & Ser. Co., of St. Louis.

BALFOUR, N. D.—A franchise, it is reported, has been granted to the owners of the local flour mill to install and operate an electric-light plant in Balfour. The proposed plant is to be completed by May 1.

WILLISTON, N. D.—Within the next six months the electric light and water-works commission expects to install a complete filtering plant with water-driven pumps of 500,000-gal. capacity; also within the next three months to purchase two 50-hp motors. George A. Bissell is superintendent of water and light department.

ELKTON, S. D.—At an election held recently the proposal to issue $25,000 in bonds for the purpose of installing a municipal electric-light plant was carried. Work will begin on the construction of the plant as soon as the weather will permit.

ELLENDALE, S. D.—The City Council has granted J. L. Tucker a franchise to construct and operate an electric-light plant in Ellendale for a period of 30 years. The Council has entered into an agreement for street-lighting to the amount of $1,500 per year.

SPENCER, S. D.—Steps have been taken by local business men to organize a stock company for the purpose of installing an electric-light system here. In case sufficient stock is not subscribed, a franchise will probably be granted to an outside company.

NORTH PLATTE, NEB.—The North Platte Gas & El. Co. has been reorganized under the name of the North Platte El. Co. and will be operated by the Union Co. of Omaha, Neb. The electric plant will be rebuilt and entire new equipment installed. Willis Todd, of Omaha, is engineer in charge of the work.

Southern States

MORGANTOWN, N. C.—Within a short time the electric light commissioners expect to purchase one second-hand 50-kw, three-phase, 2300-volt generator directly connected to an engine and a switchboard to control same.

ROWLAND, N. C.—Bids will be received at the office of J. McR. Braey, Mayor, Rowland, N. C., until March 10, for installing an electric-light plant, water-works and sewerage systems in the town of Rowland. Plans and specifications are on file in the office of J. B. McCrary Co., Atlanta, Ga. For further information address O. P. Chitty, clerk board of commissioners.

VANCEBORO, N. C.—The citizens have voted to establish an electric-lighting system in the town, which will be installed as soon as bids can be secured.

WILSON, N. C.—The Board of Town Commissioners, it is reported, has decided to rebuild the municipal electric-light plant. Bids were advertised to be received until Nov. 4, 1913, for equipment for the plant, but the matter was postponed indefinitely owing to the town being unable to sell the bonds. It is proposed to install a plant with an output of 800 kw in duplicate units.

DENMARK, S. C.—The Carolina Public Ser. Co., of Denmark, is installing an electric-light plant in Denmark, and will soon be ready to purchase electrical supplies. It would like to receive catalogs pertaining to same. The company does not want wire or machinery. F. M. Stansbrough is manager.

GREER, S. C.—John N. Ambler, Winston, N. C., has been employed to supervise the construction of a municipal electric-light plant, for which $67,000 in bonds have been issued. T. W. White is city clerk.

ALBANY, GA.—The Albany Pwr. & Mfg. Co. expects to install within the next twelve months one 750-kw, 2300-volt, three-phase, 60-cycle turbo-alternator, complete with condensing system. E. S. Killebrew is superintendent.

BARTOW, GA.—Preparations are being made by the city of Bartow for the construction of a municipal electric-light plant. Contracts for machinery, it is said, have been awarded.

CORDELLE, GA.—The City Council is contemplating the installation of a municipal electric-light plant to supply electricity for the ornamental lighting system. It is proposed to install a generator and engine in connection with the new waterworks system. A committee, consisting of Mayor Fred Harder and J. J. Williams, has been appointed to make investigations in regard to same.

BARTOW, FLA.—Bonds to the amount of $20,000, it is reported, have been voted, the proceeds to be used for extension and improvements to the municipal electric-light systems.

MELBOURNE, FLA.—Within a few months matters will be in shape for the installation of a municipal electric-light plant, for which bonds were recently issued. J. V. E. Wiles is city clerk.

PALM BEACH, FLA.—The Atlantic Fish Co., it is reported, is contemplating the construction of an electric-light plant, ice factory and cold-storage plant. The building will be 140 ft. by 56 ft.

COLUMBIA, TENN.—Application has been made to the town of Columbia by John H. Carpenter and associates for a 20-year franchise to install and operate an electric light, power and heating system in Columbia.

DUCKTOWN, TENN.—The Tennessee Copper Co., it is reported, contemplates equipping the machinery in its mines for electrical operation.

TUSCALOOSA, ALA.—Bonds to the amount of $600,000, it is reported, have been issued by the Birmingham-Tuscaloosa Ry. & Utilities Co. The proceeds, it is said, will be used for the construction of a new central generating plant and gas holder, for extending gas distributing system, and for equipping for electrical operation and extending steam belt railway. The company is also contemplating the erection of wharves and loading docks.

HEBER SPRINGS, ARK.—The Arkansas Hydro-Electric Co., of Heber Springs, is contemplating the construction of a hydroelectric power plant on the Little River, near Heber Springs, to develop about 10,000 hp at a cost of about $2,000,000. Present plans provide for three dams—one power dam, 600 ft. long by 90 ft. high, and two reservoir dams, 1400 ft. and 800 ft. long respectively and each 90 ft. high. Four generating units, consisting of a waterwheel and generators of 25,000 hp each, will be installed. The turbines will operate under a 90-ft. head, with 70,000 cu. ft. of water per minute.

MAGAZINE, ARK.—The Magazine El. Co., it is reported, has been granted a franchise to construct and operate an electric-light plant here.

ABBEVILLE, LA.—The City Council has decided to make improvements to the municipal electric-light plant, to cost about $25,000. Harold Raymond, of New Orleans, has been engaged to prepare plans and specifications.

DUSTIN, OKLA.—The Dustin Lt. & Pwr. Co., whose plant was recently destroyed by fire, purchased new equipment immediately, including one 70-hp Rathbun gas engine and one 50-kw Fort Wayne three-phase, 220-volt generator, and has resumed operation. C. E. Kapp is owner of the plant.

LAWTON, OKLA.—At an election held recently the proposal to grant the Lawton Ltg. & Ry. Co. a franchise to construct and operate an electric railway on the streets of the city was carried.

QUINTON, OKLA.—The franchise for an electric-light plant held by S. A. Burnham has been purchased by T. M. Morrill, M. T. Crane and James Fargarton, who will begin work at once on the installation of an electric-light plant.

DALLAS, TEX. — The commissioners' court of Dallas County has granted a franchise to the Texas Pwr. & Lt. Co. for the construction of a telephone line from Dallas to Eagle Ford and Cement City, to be used in connection with the electric power supply line being installed by the company into Cement City.

DALLAS, TEX.—The contract for the general construction of the new building for the Neiman-Marcus Co., at the corner of Main and Ervay Streets, Dallas, has been awarded to the Watson Construction Co., of Dallas, at $109,995. Bids for elevators, electric wiring, heating and plumbing will be asked for within 60 days. Hubbell & Green, of Dallas, Tex., are architects.

FREEPORT, TEX.—The Freeport Sulphur Co., of Freeport, is planning to install a central electric power plant in connection with the new superheated water and power plant now being installed at its mines in Bryan Heights. Electricity generated at the plant will be used to operate the machinery in the mines, including the pumps for pumping water from the canal, and fuel oil from the tanks on the Freeport ship channel to the mines, and for lighting purposes. The plant will also furnish electricity for lamps and motors in Freeport. The equipment will be installed by Westinghouse, Church, Kerr & Co., of New York, N. Y., and it will include a 200-kw Westinghouse steam turbine directly connected to generator.

HICO, TEX.—The City Council has granted the Hico El. & Pwr. Co. a franchise to erect and maintain transmission lines in this city for a period of 40 years. The company is at present furnishing electrical service in Dublin and is now extending its transmission lines to Walnut Springs to furnish electricity there. The central station of the company is in Hico.

HOUSTON, TEX.—Bids will be received by E. B. Bonney, city secretary, Houston, until March 23, for the erection of a three-story fireproof city hall annex, the work to be let in four contracts as follows: General work, heating, plumbing and wiring. Bids are to be submitted on blanks prepared by Sanguinet, Staats & Gottlieb, architects. Plans and specifications are on file in the office of the architects, where copies may be obtained.

POST CITY, TEX.—The Post Pwr. Co. plans to purchase within the next few months wire, cross-arms, lightning arresters, insulators and meters for the electric lighting system, and also 50 street lamp hoods. H. W. Fairbanks is vice-president and general manager.

STAMFORD, TEX.—A carload of poles 25 ft. long will be purchased within the next few months by the Stamford Gas & El. Co. J. E. Johnson is president.

Pacific States

BURLINGTON, WASH.—The Burlington El. Co. has recently sold its plant to the Pacific Northwest Traction Co., Seattle, Wash.

VISALIA, CAL.—The Mount Whitney Pwr. & El. Co., of Visalia, expects to erect in the next four months additional substations, with a total output of 10,000 kw, and to purchase line material for 200 miles of transmission lines. Fred G. Hamilton is superintendent.

FAIRVIEW, UTAH. — The municipal electric-light plant expects to erect about 2 miles of transmission line and also to purchase three transformers within the next three months. Nephi Cruser is manager.

WILLARD, UTAH.—The property of the Willard Power Co. has been purchased by the Utah Pwr. & Lt. Co., Salt Lake City, Utah.

WHITE SULPHUR SPRINGS, MONT.—We are informed that the town of White Sulphur Springs does not contemplate the installation of an ornamental street-lighting system as reported in the issue of Feb. 14. George Wallwork is town clerk.

ALAMOGORDO, N. M.—The Alamogordo Wtr. Wks. Co. is preparing to erect a new power plant which will furnish energy for the operation of pumping plants for irrigation purposes in the Alamogordo valley. A new Diesel oil engine will be installed, it is reported.

Canada

CALGARY, ALTA.—Tenders will be received by the Electric Department of Calgary until March 18 for two 3000-kw, 12,000-volt transformers for the municipal electric-light system.

DUNCAN, B. C.—Preparations have been completed for the installation of a municipal electric-light plant, for which contracts were awarded Feb. 27. The equipment will consist of two 60-kw generators and two 100-hp oil engines, with switchboard complete. Transmission line will be 2200 volt, three-phase, 60-cycle. Construction work will begin immediately. P. G. Harvey is engineer in charge.

KAMLOOPS, B. C.—The contract for the erection of a pole transmission line from the municipal hydroelectric generating plant on Barriere River and the substation in Kamloops, a distance of 43 miles, has been awarded to T. R. Cornick, contracting engineer, of Vancouver. The contract calls for the use of 45-ft. wooden poles with steel-core aluminum conductors, equivalent to No. 4, B & S gage, solid copper. Spans will average 200 ft. This will be 45,000-volt line using pin-type insulators. DuCane, Dutcher & Co., of Vancouver, are consulting engineers for the city in connection with the hydroelectric system.

MONCTON, N. B.—The City Council has authorized plans to be prepared for the installation of a new system of street-lighting.

HAMILTON, ONT.—The Board of Control, it is reported, is considering the installation of a steam auxiliary power plant in connection with the water-works system, to be used in case the high-tension transmission line is out of service.

PLATTSVILLE, ONT.—A by-law has been passed authorizing the Council to close a contract with the Hydro-Electric Power Commission of Ontario to furnish electrical energy to Plattsville.

TORONTO, ONT.—Tenders will be received by the Toronto Hydro-Electric System until March 12 for transformers. Specifications and form of tender may be obtained at the office of the purchasing agent of the Toronto Hydro-Electric System.

MONTREAL, QUE.—Plans have been prepared for laying additional conduit for which tenders will be called in the early spring. A special conduit for the Montreal Tramways Co. will be built from the company's power house on William Street to McGill Street, where it will be linked with the general scheme. Preparations are also being made for drawing the wires into the conduit already laid.

SASKATOON, SASK.—The City Council has entered into an agreement to supply electricity to the Northland Milling Co., at Factoria, on the northern outskirts of the city. An overhead transmission line will be erected from the power house to Factoria. The city will bear the expense to the city limits and the company for the rest of the way.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until March 14, for furnishing copper and steel wire, track bolts, plate washers, drills, breast drills, chain blocks, tackle blocks, gaskets, creosoted switch ties, etc. Blanks and general information relating to this circular (No. 831) may be obtained at the above office or from the offices of the assistant purchasing agents at 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until March 20, for furnishing operating devices for pivoted sash, track bolts, wire, cable, chain, cable clips, grommets, belt rivets and burrs, sheet brass, marine clocks, etc. Blanks and general information relating to this circular (No. 832) may be obtained at the above office or from the offices of the assistant purchasing officers at 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1986 North Point Street, San Francisco, Cal.

PANAMA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 28 for construction of four steel towers on the Canal Zone. Separate proposals will be received for steel work and foundation. Plans and specifications may be obtained upon application to the bureau. H. R. Stanford is chief of bureau.

New Incorporations

HUNTINGTON, ARK.—The Huntington El. Lt. & Pwr. Co. has been organized with a capital stock of $8,000. The officers are: John Degen, president, and H. E. Cunningham, secretary.

DULUTH, MINN.—The Western Mesaba El. Co. has been incorporated with a capital stock of $100,000 by Frank McCormack, J. A. Hanks and M. J. McCormack.

BENSON, N. C.—The Benson El. Lt. Co. has been granted a charter with a capital stock of $50,000 for the purpose of installing an electric-light plant in Benson. The incorporators are: W. S. Murchison, A. B. Hudson and others.

MONTPELIER, VT.—The Bread Loaf Mountain Pwr. Co. has been organized with a capital stock of $5,000 for the purpose of developing power on the Middlebury River and its branches, and on the Lamoille River, to generate electricity and distributing same for lamps and motors.

Directory of Electrical Associations, Societies, Etc.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, H. O. Hanson, Mobile Gas Co., Mobile, Ala. Semi-annual meeting, Mobile, Ala., May, 1914.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Permanent secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary-treasurer, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION. Secretary, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. General meeting, New York, April 16-18.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary, Eugene W. Stern, 101 Park Ave., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS. Secretary, William H. Ross, 154 Nassau St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. Secretary, Edwin A. Scott, 29 West 39th St., New York.

AMERICAN WATER WORKS ASSOCIATION. Secretary, J. M. Diven, 47 State St., Troy, N. Y. Annual meeting, May.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Little Rock, April 21-23, 1914.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Geo. C. Holberton, Pacific Gas & Electric Co., San Francisco, Cal.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, W. T. Snyder, McKeesport, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Jos. A. Andreucetti, Chicago & Northwestern Railway, Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 112 West Adams St., Chicago. Annual meeting, New Orleans, May 19-22.

CALIFORNIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, W. S. Hanbridge, 1408 Merchants' National Bank Building, Los Angeles, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Secretary-treasurer, J. H. Larmonth, 610 Confederation Life Bldg., Toronto, Can.

COLORADO ELECTRIC CLUB. Secretary, C. F. Oehlmann. Meets every Thursday at Albany Hotel, Denver, Col.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

COMMERCIAL SECTION, N. E. L. A. Secretary, J. F. Becker, 1170 Broadway, New York.

EASTERN NEW YORK SECTION, N. E. L. A. Secretary, C. S. Van Dyck, Schenectady, N. Y.

ELECTRIC CLUB OF CHICAGO. Secretary, Fred M. Rosseland, Monadnock Block, Chicago. Meets every Thursday noon at Hotel Sherman.

ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER BOSTON. Secretary, R. S. Hale, 39 Boylston St., Boston.

ELECTRICAL CONTRACTORS' ASSOCIATION OF MASSACHUSETTS. Secretary, H. D. Temple, 30 Foster St., Worcester, Mass.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF THE CITY OF CHICAGO. Secretary, M. N. Blumenthal, 179 West Washington St. Meets at noon on the second and fourth Wednesday of each month at 424 South Wabash Ave.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, A. J. Burns, 318 West Tenth St., Kansas City, Mo.

ELECTRICAL CONTRACTORS' ASSOCIATION OF WISCONSIN. Secretary, Albert Petermann, 626 Lloyd St., Milwaukee, Wis.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

ELECTRICAL CREDIT ASSOCIATION OF PHILADELPHIA. Secretary, John W. Crum, 1324 Land Title Building, Philadelphia, Pa.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Meeting, San Francisco, second Thursday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d St., New York.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA, NEW ENGLAND SECTION. Secretary, L. L. Edgar, 39 Boylston St., Boston.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

FARADAY ELECTRICAL ASSOCIATION. Secretary, W. J. Collins, 1129 Masonic Temple, Chicago. Meets at noon on the first and third Wednesday of each month at Planters' Hotel.

GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-treasurer, Prof. H. V. Bozell, Norman, Okla. Annual meeting, May, 1914.

HYDROELECTRIC SECTION, N. E. L. A. Secretary, S. A. Sewall, 29 West 39th St., N. Y.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, J. D. Israel, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia, Chicago and Pittsburgh.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, A. Newburger, 1153 Myrtle Ave., Brooklyn, N. Y.

INDEPENDENT TELEPHONE ASSOCIATION OF AMERICA. Secretary, W. S. Vivian, Grand Rapids, Mich.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donahue, Lafayette, Ind.

INSTITUTE OF OPERATING ENGINEERS. Secretary, L. Houmiller, 29 West 39th St., New York.

INSTITUTE OF RADIO ENGINEERS. Secretary, E. J. Simon, 81 New St., New York.

INTERNAL-COMBUSTION ENGINEERS' ASSOCIATION. President, Charles Kratsch, 416 West Indiana St., Chicago. Meeting second Friday of each month at Lewis Institute.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTRICAL CONGRESS. Secretary-treasurer, Preston S. Millar, 80th St. and East End Ave., New York. San Francisco, Sept. 13-18, 1915.

INTERNATIONAL ENGINEERING CONGRESS. Secretary-treasurer, W. A. Cattell, Foxcroft Building, San Francisco, Cal. Congress, San Francisco, September, 1915.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Meeting at San Francisco, Sept. 6-11, 1915.

IOWA ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Annual meeting, Cedar Rapids, April 23. Secretary, H. B. Maynard, Waterloo, Ia.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia. Annual meeting, Cedar Rapids, April 23.

JOVIAN ORDER. Jupiter (president), W. N. Matthews, St. Louis, Mo.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary-treasurer, Ivor Thomas, 237 South Main St., Wichita, Kan.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, J. J. Ziegler, 227 Bourbon St. Meeting every Wednesday, Audubon Building, New Orleans.

MAINE ELECTRIC ASSOCIATION. Secretary-treasurer, Walter S. Wyman, Waterville, Maine.

MICHIGAN ELECTRIC ASSOCIATION. Affiliated with N. E. L. A. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

MINNESOTA ELECTRIC ASSOCIATION. Secretary-treasurer, F. A. Otto, St. Paul Gas Light Company, St. Paul, Minn. Annual meeting, Minneapolis, March 18-20, 1914.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the National Electric Light Association. Secretary-treasurer, Frank J. Duffy, Natchez, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY AND WATER WORKS ASSOCIATION. Secretary-treasurer, F. D. Beardslee, Union Electric Light & Power Co., St. Louis. Annual meeting, May 21-23.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, Wm. L. Smith, Concord, Mass.

NATIONAL DISTRICT-HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual convention Rochester, N. Y., May 26-28.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual meeting, Philadelphia, June 1-5.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, George H. Duffield, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago. Annual meeting, June, 1914.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass. Open meeting, New York, March, 1915.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, J. B. Earle, Waco, Texas.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, S. J. Bell, David City, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 60 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, H. A. Faulkner, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, S. J. Stewart, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

NEW YORK ELECTRIC RAILWAY ASSOCIATION. Secretary, Charles C. Dietz, 239 West 39th St., New York.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Affiliated with the National Electrical Credit Association. Secretary, Franz Nellson, 80 Wall St., New York.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York. Annual meeting, New York, June, 1914.

NORTHWESTERN CEDARMEN'S ASSOCIATION. Secretary, R. N. Boucher, 743 Lumber Exchange, Minneapolis, Minn.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University. Columbus, Ohio.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, F. C. Green, 291 East Morrison St., Portland, Ore. Annual meeting, Portland, June 8-9.

PENNSYLVANIA ELECTRIC ASSOCIATION (State Section N. E. L. A.). Secretary-treasurer, S. C. Pohe, Bloomburg, Pa.

RAILWAY SIGNAL ASSOCIATION. Secretary-treasurer, C. E. Rosenberg, Times Building, Bethlehem, Pa.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York. Annual meeting, New York, May 12.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Prof. H. H. Norris, Ithaca, N. Y. Annual meeting, Princeton, N. J., June.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, A. A. Wilbur, Columbus, Ga. Annual meeting, Isle of Palms, Charleston, S. C., Aug. 19-21, 1914.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Tex. Annual convention, Galveston, Tex., May 20-23.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Manchester, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 76 West Monroe St., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, Stephenson Building, Milwaukee, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 24, 1914.

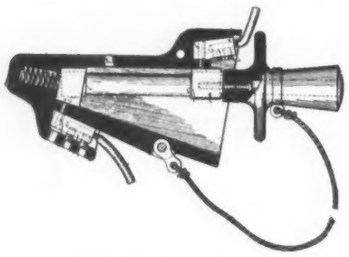
[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,087,917. BLOCK-SIGNAL SYSTEM; E. F. Bliss, Schenectady, N. Y. App. filed Aug. 3, 1908. "Normal danger" type having few live wires.

1,087,937. ELECTROLYTIC GENERATOR; C. Ellis, Montclair, N. J. App. filed May 29, 1913. For producing hydrogen and oxygen.

1,087,966. AUTOMATIC CONTROL OF SIGNALS BY LIGHT; W. A. Moffett and R. P. Perkins, San Francisco, Cal. App. filed July 24, 1912. Embodies electromagnetic means combined with a selenium element.

1,087,969. MULTIDUCT; T. E. Murray and A. V. A. McHarg, New York, N. Y. App. filed April 30, 1913. Formed from sheet metal rolled to form longitudinal crenelations.



1,087,971—Fuse Switch

1,087,971. FUSE SWITCH; T. E. Murray and G. W. Christians, New York, N. Y. App. filed Nov. 7, 1913. A cartridge-fuse case provided with a suitable handle forms the switch lever.

1,087,972. MOTOR-CONTROL SYSTEM; R. C. Newhouse, Cincinnati, Ohio. App. filed April 22, 1910. For imparting a shaking motion to the dipper of a power-driven shovel.

1,087,985. INCANDESCENT-LAMP SUSPENSION; H. R. Sargent, Schenectady, N. Y. App. filed Nov. 23, 1912. Lamp-holding means adapted to be readily applied to or detached from installed catenary suspension wires.

1,087,997. ELECTRO-PNEUMATIC BRAKE; W. V. Turner, Edgewood, Pa. App. filed July 18, 1911. In which pneumatic brakes may be controlled electrically at one time and automatically at another time by varying the pressure in the train pipe.

1,088,003. RESISTANCE GRID; N. Wilkinson, Milwaukee, Wis. App. filed April 8, 1911. Made up of sheet-metal elements.

1,088,018. MEANS FOR WORKING MICROPHONES IN PARALLEL; R. Goldschmidt, Berlin, Germany. App. filed Oct. 1, 1912. So that when influenced by a common sound wave the energy required for transmitting the sound is increased accordingly.

1,088,101. GROUNDING DEVICE; H. E. Schimmel, Providence, R. I. App. filed Dec. 1, 1911. Grounds the wire without using the bushing heretofore required to be soldered to the end of the conduit.

1,088,114. UNIT OR GRID; E. C. Van Glahn, New York, N. Y. App. filed Sept. 19, 1913. For use in electric ranges.

1,088,120. PORTABLE SELF-CONTAINED ELECTRIC LAMP; F. T. Baird, Blue Island, Ill. App. filed June 11, 1913. For railroad use in place of the customary hand lantern.

1,088,157. MANUFACTURE OF ELECTRICAL RESISTANCES; A. W. Maley, West Bromwich, England. App. filed Oct. 8, 1910. Uses grid of steel or iron containing high percentage of carbon.

1,088,165. ELECTRIC-LAMP FIXTURE; T. Nelson, Chicago, Ill. App. filed Aug. 18, 1913. Wall-bracket structure.

1,088,197. DEVICE ON TRANSFORMERS FOR PREVENTING THE DECOMPOSITION OF OIL BY THE OXYGEN CONTAINED IN AIR; A. Aichele, Baden, Switzerland. App. filed Dec. 15, 1911. Does not require the transformer box to be sealed hermetically.

1,088,210. STORAGE-BATTERY INSULATION; J. N. Davis, Denver, Col. App. filed May 27, 1912. To prevent short-circuiting of the shells between the positive and negative plates.

1,088,246. RAILWAY SIGNALING SYSTEM; J. B. Struble, Wilkinsburg, Pa. App. filed July 24, 1909. Block signal system particularly adapted to alternating current.

1,088,268. ELECTRIC-CIRCUIT BREAKER AND THE LIKE; E. A. Fagerlund, Stockholm, Sweden. App. filed April 22, 1912. Automatically operating time switch.

1,088,270. TELEPHONE SYSTEM; W. A. Fricke, Chicago, Ill. App. filed March 26, 1912. Common-battery multiple-switchboard system.

1,088,276. ARC LAMP; J. Härden, Schenectady, N. Y. App. filed May 4, 1905. Special feeding mechanism and circuit arrangement.

1,088,278. RAIN GUARD FOR INSULATORS; M. K. Holmes, Muncie, Ind. App. filed April 16, 1913. Centrally perforated guard plate having spring fingers to embrace the body of an insulator.

1,088,283. TELEPHONE; P. L. Jensen and F. S. Pridham, Napa, Cal. App. filed March 19, 1912. Loud-speaking sensitive telephone receiver.

1,088,296. ELECTRODE; J. W. Richards, South Bethlehem, Pa. App. filed May 12, 1913. Has heat-retarding gaps containing a compound of aluminum.

1,088,327. ACCOUNTING SYSTEM; W. J. Crumpton, Evanston, Ill. App. filed May 17, 1909. Workman's time recorder.

1,088,343. PROCESS FOR MAKING FILAMENTS AND FILAMENTOUS PLATES FOR STORAGE-BATTERY ELECTRODES; H. C. Hubbell, Newark, N. J. App. filed June 26, 1911. Aggregates alternate layers of different metals, unites by welding, subjects to pressure and cuts resulting sheet into strips or bars.

1,088,363. ELECTRIC-RAILWAY SIGNAL SYSTEM; A. Pillich, Lackawanna, N. Y. App. filed March 28, 1910. Signals received on the train.

1,088,374. ELECTRIC BATTERY AND ACCUMULATOR; F. Sablon, Faches-Thumesnil, France. App. filed Aug. 15, 1913. Packing composed of baked mixture of double silicate of magnesia and lime and trisilicate of magnesia.

1,088,402. ELECTRIC INSULATING FITTING; J. F. Burns, Philadelphia, Pa. App. filed March 22, 1911. Adapted to be fitted in the end cap of a conduit and in openings in the terminal boxes.

1,088,448. TIMED DETONATOR FOR EXPLOSIVES; M. W. Quiggle and G. E. Bailey, Los Angeles, Cal. App. filed May 6, 1911. Transmission of fire from ignition means to detonating material is regulated to consume greater or less time.

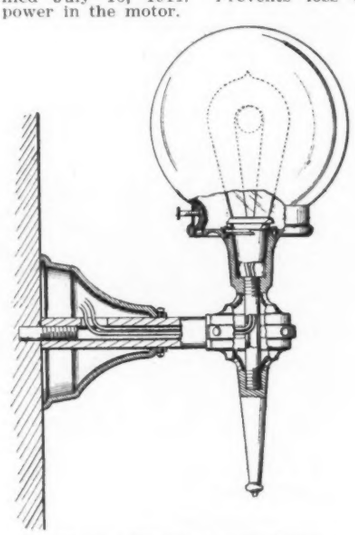
1,088,454. SWITCH INDICATOR; C. M. Roe, Jersey City, N. J. App. filed Nov. 25, 1911. Indicates to engineer in entering the yard just what track is open to him.

1,088,489. SELF-REGULATING DYNAMO-ELECTRIC MACHINE; C. A. Vandervell and A. H. Midgley, Acton Vale, England. App. filed July 8, 1913. For car-lighting systems.

1,088,499. ELECTRO-MECHANICAL PLAYER FOR MUSICAL INSTRUMENTS; J. F. White, Pittsburgh, Pa. App. filed Nov. 13, 1908. Attachment for ordinary pianos.

1,088,503. ELECTRICAL STEERING GEAR; J. D. Williams, Jr., Philadelphia, Pa. App. filed Feb. 16, 1910. Includes hand switch for starting the motor and automatic means operated by the motor for returning the switch to its off position.

1,088,517. MEANS FOR REGULATING THE SPEED OF ASYNCHRONOUS OR INDUCTION MOTORS; J. Bethenod, Paris, France. App. filed July 18, 1911. Prevents loss of power in the motor.



1,088,165—Electric-Lamp Fixture

1,088,527. COMBINED ELECTRIC-LIGHT SYSTEM; J. H. Burcham, Danville, Ill. App. filed June 9, 1913. For use on locomotives so arranged that arc-light and incandescent lamps may be synchronously maintained lighted.

1,088,531. PORTABLE STORAGE-BATTERY CASE; J. C. Callier, Roslyn, Wash. App. filed July 9, 1913. For miners, fuse being located in the case to prevent possibility of explosion.

1,088,541. AUTOMATIC EXCHANGE SYSTEM FOR THE TRANSMISSION OF INTELLIGENCE; F. S. Coulter, Livonia, Ind. App. filed April 9, 1913. Avoids need of manually operated exchange system.

1,088,607. ELECTRIC-LAMP STAND; W. A. McKay and M. Claussen, San Francisco, Cal. App. filed April 3, 1912. A means for clamping it to a support and a concealed reel for winding extra cord.

1,088,611. DEVICE FOR SIGNALIZING THE PRESENCE OF EXPLOSIVE GAS MIXTURES IN FIRE-DAMP MINES; H. Neubauer, Gotha, Germany. App. filed Feb. 25, 1913. Has inclosed explosion chamber which signalizes presence of the gas to a distant point.

1,088,648. CIRCUIT-CONTROLLING LOCK; T. N. Birch, Kansas City, Mo. App. filed Sept. 30, 1912. For automobile ignition service.

1,088,657. REVERSING AND CONTROLLING GEAR; J. P. Hall, Oldham, England. App. filed May 15, 1913. For automatically controlling an electric motor in a predetermined cycle.